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ABSTRACT

This project examined three hypotheses: (1) teachers can learn to make explicit their own intuitive knowledge as it relates to specific matters and their teaching practice; (2) once a teacher has gained insight into her own knowledge, she can learn to coordinate it with the privileged descriptions of subject matters she is expected to teach; and (3) these skills can serve as a resource for contacting, understanding, and making good descriptions of students' intuitive ways of constructing coherence. Part one of this report gives the background and current state of the project. Part two discusses the hypotheses and tentative evidence for both confirmation and disconfirmation, as well as some unanticipated results. In part three, ways are discussed in which the field of cognitive psychology was drawn upon in the research and how it became a viable tool in teacher development. In part four, a theoretical model is proposed for use in analysis of protocols within problem-solving situations. One worked-out example is included. Part five is a discussion of the effect of the program in the teacher-participants' classrooms. Several appendices are attached--interim reports, published papers pertaining to the project, and other documents associated with the work. At appropriate places in this report, particular directions and explicit questions currently under investigation are indicated. (JD)

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Final Report:

An Experiment in Teacher Development

(NIE Grant # G-78-0219)

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March 1981

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SP 028 034

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Sometimes a most curious demand is made: that one should present experiences and perceptions without recourse to any kind of theoretical framework, leaving the student to establish his conviction as he will. But this demand cannot be fulfilled even by those who make it. For we never benefit from merely looking at an object. Looking becomes considering, considering becomes reflecting, reflecting becomes connecting. Thus, one can say that with every intent glance at the world we theorize. To execute this, to plan it consciously, with self-knowledge, with freedom, and, to use a daring word-- with irony-- requires a considerable degree of skill, particularly if the abstraction we fear, is to be harmless and if the empirical result which we hope to achieve, is to be alive and useful. (Goethe, 1810)

PART I: BACKGROUND AND OVERVIEW

This is the final report on the results of a two-year teacher development project funded by NIE (NIE# G-78-0219). The report is in five parts. Part I gives the background and current state of the still on-going project. Part II includes a discussion of the initial hypotheses and tentative evidence for both confirmation and disconfirmation of these initial hypotheses, as well as some unanticipated results. Part III suggests ways in which we have drawn upon the field of cognitive psychology in this research and how it has become a viable tool in teacher development. In Part IV we propose a theoretical model for use in analysis of protocols within problem-solving situations. One worked out example is included. Part V is a discussion of the effect of the program in the teacher-participants' classrooms. In addition, several appendices are attached-- interim reports, published papers pertaining to the project and other relevant documents associated with our work to date. While the report covers work undertaken during the grant period, further analysis of the data is continuing under a current NIE grant (# G-81-0042). Thus, results described here should be taken as tentative and incomplete. We have indicated at appropriate places in this report particular directions and explicit questions which are currently under investigation.

Year One: September, 1978 to June, 1979

An Experiment in Teacher Development was funded by NIE in September of 1978. In that month the principle investigator, Bamberger, recruited three staff members: Eleanor Duckworth, a cognitive psychologist and educator and Magdalene Lampert, an experienced teacher educator, as project

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coordinators and Gary Greenberg, a graduate student at Harvard. By October, 1978, we had, in turn, recruited 8 elementary school teachers from the Cambridge schools. Recruiting was done, with the approval of the Cambridge School Department, through distribution of announcements of the program placed in the mailboxes of every teacher in the Cambridge elementary schools. Fourteen teachers responded and were interviewed. Eight were chosen, primarily because these 8 shared a common time during which they could meet in a once-a-week seminar. One of the group dropped out shortly after the seminar began due to a conflict with her previous commitment to the developing bi-lingual program. The 7 remaining teachers fortunately provided us with a wide range of characteristics along nearly every relevant dimension--age, years of teaching experience, type of school and school population and type of classroom or teaching style. However, not surprisingly, all the teachers were women. (See page 2A).

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TEACHER CONSULTANTS

Name	Grade	School	Teaching Experience	Description of School
Joanne Cleary	3-4	Magnet Open Class/Tobin	4 years	TOBIN: a large, modern school; the magnet class draws from the entire city and is chosen by parents.
Corinne Caile	Elementary Reading Coordinator	Morse	8 years	MORSE: a small school in a racially mixed working class community.
Virginia Chalmers	K-1	Open School at M.L. King	5 years	M.L. KING: a large, modern school drawing from a largely black community along with many student families.
Mary Rizzuto	4	Gore	4 years	GORE: a tiny school in a Portuguese neighborhood.
Mary di Schino	1	M.E. Fitzgerald	8 years	M.E. FITZGERALD: a medium-sized old school with children from working class and also university families.
Susan Wheelwright	4-5	Agassiz	7 years	AGASSIZ: a medium-sized old school in a university and professional neighborhood with some children from working class families.
Patton Tabors	6	Webster	2 years	WEBSTER: a small old school in a lower-class black neighborhood.

From October 1978 through June, 1979, the group met every week for three hours, after school (4-7 P.M.). Each teacher was paid $500 as a consultant to the project and was given an additional $100 to use in some personal way associated with the project. Three of the 7 teachers elected to apply this money to tuition at Leslie College where they received credit for the seminar. One teacher used the money to buy materials for her classroom; the remaining teachers did not made a proposal for expenditure of these funds.

All sessions were video-taped and audio-taped, making a total of 50 hours during the first year of the project alone. The staff met in regular review meetings for at least five hours each week in addition to individual reviewing of each week's video-tapes. These sessions included not only analysis of the preceding session but also planning for the subsequent session. Specific responsibility for weekly seminars revolved among the Principle Investigator and the two other primary staff members. The graduate student participated in the review sessions and was also responsible for manning the video camera, cataloguing and indexing the tapes, as well as handling all other technical materials and services (including computer-related activities). In addition, the two project coordinators visited each teacher's classroom 3-4 times during the year and all the teachers were interviewed individually. Finally, each teacher kept an on-going log in which she recorded comments on the seminar sessions, and observations on her classroom and other related thoughts. Thus, the tapes (many of them transcribed), notes on seminar sessions, staff meetings, classroom visits, and interviews, as well as teachers' logs, constitute the data from which we have derived our analysis of this first year.

Year Two: September, 1979 to June, 1980

The second year was originally designed as a follow-up, with the teachers meeting just once a month (see proposal p. 23). However, the group elected to continue meeting twice a month, arguing that less than that would not be sufficient to maintain the level of involvement they felt necessary. In addition, a second group of teachers was added to the program on the hypothesis that they would allow us to test the strategies used with the first year's group, and provide us with a basis for comparison in evaluating our findings. They met in alternate weeks, and three members of the original group attended the new group's sessions, in addition to their own.

A second major development in the second year was the addition of an adjunct teacher, Mary Gale, who worked half-time as an extra "peer" resource. She spent one half-day every week or two in the classroom of each teacher in the original group, and also attended the seminar sessions of both groups. Initially, she was hired in response to the teachers' expressed need for more time to observe individual children in their classrooms. However, her role both in the seminar (where she was a regular teacher-participant) and in the classroom played a much more central role in achieving the goals of the project than had initially been foreseen. An excerpt from her report is included in Appendix 3.

The new group of teachers (hereafter referred to as Group B) was recruited in the same way as the first group (hereafter referred to as Group A). Duckworth took responsibility for Group B, while Bamberger

assumed responsibility for Group A and Lampert became documenter for both groups. Groups A and B met on alternate weeks and all sessions were once again video-taped by Richard Carter, an MIT graduate student in psychology and education, who replaced Gary Greenberg.

Appendix I includes brief summaries of each session for the first year. It will be seen that the first year was devoted mainly to "experiments" in several domains: music, physics and an investigation of the moons habits. In addition, there were several sessions of analysis of video-taped protocols involving children. It was only towards the end of the year that we asked the group to bring in "stories" from their classrooms. These focussed on puzzling or otherwise intriguing incidents usually involving one child. In the second year, much more time was spent on issues related to the teachers' classrooms. However, experimenting continued with moon observations and with music. In several sessions, the focus was on inventing notations for small, group-composed, percussion pieces. The evaluation of one notation scheme was particularly interesting as it evoked considerable discussion on the issue of "units" in measuring time in music as compared with "units" for measuring other kinds of phenomena as, for example, in graphs. These concerns led, in turn, to questions about "privileged descriptions" and their "rightness" in the face of possible alternatives. (See Parts IV and V.) Also, during this second year, Duckworth worked with small groups of children who were visitors to the seminar, on classical Piagetian tasks, in particular to demonstrate the "clinical interview" process (see below, Part III).

Like the A group, the B group, in its one year, focussed primarily on in-depth investigation of seemingly simple phenomena. Starting with chip trading activities, similar to those carried out in many primary classrooms, the teachers soon moved to the invention of algebraic formulas to express relationships they discovered. At the same time, they moved to reconsider things they thought

they "knew" in arithmetic, pushed largely by a question that occurred to one teacher during chip-trading activities: "Why is it that long division is the only one that is done from left to right? Addition, subtraction and multiplication of big numbers are all done from right to left."

While arithmetic was thus the primary activity of Group B, they also did moon observations. Duckworth worked with children in this group, as well. As was the case in group A, the group considered the implications of the seminar's issues for the everyday life in their classrooms, one of the focusses being children's own approaches to arithmetic.

Tentative Findings

The most strikingly unexpected finding of the project, confirmed again in work with the B group, is that the process, as originally described in the proposal, takes much longer than had been anticipated. It took the first group of teachers nearly two years to integrate the meaning and value of their work in the seminar so that it is a functional aspect of their lives as teachers. Our current hypothesis is that significant learning involves serious risk-taking and that the courage to confront such risks is a long time coming. This hypothesis needs to be tested against the evidence.

In this regard, "experimenting" with simple, everyday task

situations has played a central and multi-faceted role. (See proposal pp. 20-21). It has been the basis, first, for developing the participants' capacities for cognitive self-reflection, for learning both to question and to trust their own experience. In addition, reflection on these activities has been the primary source of the groups' learning about learning and thinking. But, importantly, this has always meant thinking about thinking about directly experienced results within these experimenting situations-- a surprising observation of the moon's behavior, the surprising behavior of a ball rolling down a ramp (see Quarterly Report). Thus, new insights into such phenomena have always led to the question: How did we DO that? These reflective experimenting activities, after two years, have led to new insights into what it can mean for children to learn, as well as new views of the teacher's role in that process.

Finally, the project has benefited greatly from the interactions among the three primary staff members. Confrontation of our differing backgrounds, attitudes towards learning, teaching, and interpersonal relations, has, itself, been a significant contributing factor in the evolution of the project.

It seems clear from initial data that the seminar has been a major source of change for 5 of the 7 teachers in the A group. (One teacher dropped out in the second year to have a baby). Their sense of their roles as teachers, as adults, as learners has changed in very particular ways that still need to be made quite explicit. In addition, the teachers' sense of "schooling", what it is for, what it could be for, and

what it has been for each of them has changed in ways that an observer described as "revolutionary". This presents, indeed, one of the enigmas of the project: The teachers find themselves able to create a culture, an environment for learning, a social atmosphere in their classrooms that has led them to ponder and question the underlying values of the schools and, inevitably, of our larger culture as well. Still, in reflecting on the profound impact this realization has had, one teacher said recently of herself, "But it would be a cop-out to leave the classroom now."

The kinds of struggles with which the teachers have become involved are perhaps captured by the following set of tensions, or better, productive and non-productive conflicts which the teachers have discovered in reflecting on their classroom experience. All of these have been articulated in some way by the teachers' own account-- not always, of course, in just these terms:

Authority-experts	⟷	Personal understanding
Reflection	⟷	Action
Academic learning	⟷	Social-emotional learning
Individual	⟷	Group
Accountability	⟷	Satisfaction
Book-learning, curriculum	⟷	Experience
Answering	⟷	Questioning
Testing	⟷	"Giving a child reason" (see below, p. 11)

One of the tasks of our continuing analysis will be to document explicit situations in which these dynamic tensions have been expressed, and to analyze carefully the various means the teachers have found for coping with them-- or in some cases failing to do so. In pursuing this program,

as well as in continuing analysis, generally, we will put heavy emphasis on the role that research in cognitive psychology has played in the productive interventions of the staff in surfacing such tensions, and also in making certain aspects of psychological research relevant to the teachers, themselves. Looking ahead to the discussion in Part III, we can say, here, that instead of teaching the teachers ABOUT cognitive psychology, we have helped them to become its practitioners, albeit in a very special way.

PART II: EARLY EVIDENCE OF EFFECTIVENESS

In this section we will review the goals and hypotheses as stated in the original proposal, we also indicate some initial evidence which suggests that for some teachers the hypotheses were confirmed, but for others they were not.

Initial Goals and Hypotheses

The goals of the project as stated initially were:

> "... to extend the teacher's self-image and her intellectual engagement by providing a richer intellectual definition of her task.
>
> To help teachers develop new conceptual tools with which they can gain insight into their own ways of thinking... and through this, insight into the thinking and learning processes of the children with whom they work." (Bamberger, p. 1)

The hypotheses were as follows:

H. 1) Teachers can learn to practice skills of cognitive self-reflection. That is, they can learn to surface and make explicit their own intuitive knowledge as it relates to specific matters and to their teaching practice.

H. 2) Once a teacher has gained insight into her own knowledge, she can begin to learn to coordinate it with the privileged descriptions of subject matters that she is expected to teach in school.

H. 3) These skills can serve as a powerful resource for coming in contact with, understanding, and making good descriptions of her students' intuitive ways of constructing coherence. (Bamberger, p. 13)

It is clear from preliminary analysis that the project has had a significant impact on the participants as teachers and as learners in a way that confirms these hypotheses. Evidence for this statement comes from teachers' own accounts in the seminar, in their personal journals and in private interviews. However, the above statement still remains without value until we can articulate and document the actual events which constitute the substance of these changes.

As suggested in Part I, the profound implications of the project's goals, even as stated here, were not recognized nor certainly predicted at the time the proposal was written. In particular, the evidence is abundant that "to extend a teacher's self image" involves her in considerably more than simply "providing a richer intellectual definition of her task". On the other hand, it also seems clear that the development of "new conceptual tools" has, in turn, had a strong effect for some of the teachers in their seriously questioning, at least, their own self images.

By the end of the first year there were already clear indications of the depth of the group's commitment to and involvement with the seminar's goals. These included the group's desire to continue meeting during the second year on a more intensive basis than had been planned; their sense of commitment to one another as expressed, for example, in their initiation of visits to one another's classrooms; and their desire to remain a self-

contained, integrated group when it was proposed that new teachers be introduced into the group. Most important (as suggested earlier) was their serious questioning of the current educational enterprise as they saw it around them, now from the view of what they were beginning to see as viable alternatives.

Mini Case Studies

The kind of evidence we will want to develop in confirmation of the three hypotheses in future analyses can best be captured at this point with a few mini cases studies. The first, Case Study A, gives some concrete indication of changes among the teachers in Group A with respect to Hypothesis 3:

Case Study A: "Giving a Child Reason"

In February of the first year, the teachers were asked to watch and comment on a videotape of two boys engaged in a simple game. The two boys were seated at a table with a screen between them so they could not see one another. One boy had in front of him a pattern made of pattern blocks. The other boy had a similar set of blocks to work with and was to build the other boy's pattern by following his instructions. The attempt went far askew. The boys almost totally lost touch with one another-- unknown, of course, to the boys, themselves, since neither of them could see what the other had in front of him.

In discussing what they had seen, the teachers spoke generally of a "communication problem;" they also tended to see they boy who had the job of building the pattern from the other's instructions, as rather dull, "unable to follow directions". In contrast, the instruction-giver was seen as having "well developed verbal skills," and as being "orderly and clear" in his instructions. The teachers' analysis stopped there. They seemed to see no further way of understanding or probing for the specific events that led to the misunderstanding between the two boys.

Lampert intervened at that point to suggest that at one moment she thought she heard the boy who was giving instructions tell the other boy to take a "green square", whereas there were no green squares: all the squares were orange, and the only green things were triangles. That small, misleading instruction had, in fact, been the starting point for the second boy's difficulties. And understandably so: he had put a green thing-- a triangle-- where the other had an orange square. From then on, all the instructions had been ambiguous, but the boys had no way of knowing

that. Indeed, considering the circumstances, the boy following instructions had been remarkably inventive in trying to reconcile later instructions with what he had, quite reasonably, put before him.

When the teachers went back to view the videotape again, to see if Lampert's remark was in fact the case, they were astonished. The whole situation as they had initially seen it was reversed. They could now see exactly why the second boy made the moves he did. He no longer looked dull-- and he had, in fact, "followed instructions".

One of the teachers said of Lampert's remark, "She gave him reason". The teacher referred, of course, to the second boy, the pattern-builder, to whom Lampert had been able to "give reason"-- reason for behavior that had previously been seen as merely inattentiveness or perhaps inability to follow instructions. To "give a child reason" has become the motto, the aim, of much of the teachers' subsequent work. This is the challenge they have put to themselves every time a child does or says something whose meaning is not immediately obvious. That is, the teachers seek to understand the way in which what a child says or does can be construed to make sense-- they seek to "give him reason".

A year later there was a session parallel to this one, but in this case the role tha. Lampert had played was taken by the teachers, themselves. Duckworth had worked with 2 boys on a Piaget problem of volume, (see also Part III.) and in the discussion after the demonstration, one teacher in the B group without the tradition of "giving reason", said of a child that it was mind-boggling how he contradicted himself: She commented that the child would start to say that two buildings (that were being constructed with small cubes) had the same volume, and before a paragraph was through, he had also said that Building A had <u>more</u> volume than Building B and also that A had <u>less</u> volume than B. In watching the videotape over and over, the teachers from the "giving reason" tradition were able to point out that, in fact, while the child was using the same words ("room," "rooms," "space") as the adult who was questioning him, he was using the words in different ways and with different meanings from the adult's meanings. Once they were able to establish the meanings that the child was giving to the same words, everything that he had said became quite coherent.

This long evolution, from assuming a child is wrong, to assuming there is sense in what he says, and in being able to seek out and grasp the sense that he is making, has been a major result in confirmation of Hypotheses 2 and 3. It was surprising to us that as late as February of the first year, the notion of anything like "giving a child reason" was so far from the teachers' view of their work in the classroom. Now, nearing the end of the second year, one teacher in the original group wrote in her journal,

> "As always the task is to be <u>really</u> invested in understanding what a child is thinking. And in the very process of unearthing that, learning,

> growing, changing is going on. I feel closer to being able to do that after watching [Duckworth's work with the children, above] than ever before. I feel closer to changing the vested interest in my objectives-- or at least believing that the process alone is valuable. I guess for the first time clearly I saw children learning-- the process of learning without the answers fully in tact. Ah, so many times around on this issue,"

While the teacher's insight is, indeed, at the crux of much of what the project is all about, it was this event which seems to have brought together for her the significance of our work over the two years.

Case Studies, B, C, D: The Meaning of Self-Reflection

The next three mini cases studies are based on the individual projects designed and carried out by each of the teachers in the A Group. As evidence for Hypothesis 1, they demonstrate that "self reflection" has quite different meanings to each individual in the group.

B. For one teacher, for example, reflection has meant two things: first, she was encouraged to look more closely at what she believed herself able to do well; to consider just what it was she did know how to do. D. was confident of her ability to understand and deal with what she called social-emotional aspects of children's behavior-- e.g., sensing when a child is going to lose control, how to intervene in a confrontation between two children and even the connotations of their "play activity" as in the sand box or at the water table. By reflecting on the skills she has in these areas of confidence, she has come to see that those same skills can be applied to what she calls "more symbolic activities" like reading and number skills.

Secondly, this new awareness has taken the form of more active reflection in her observations of just one child. This work was carried out together with the adjunct teacher, who served both as "another pair of eyes" and also as a source of reflection back to her own ideas. D. noted that the child - she chose to observe had typically been characterized as "falling down; literally flipping a lot," thus, often disrupting the children around him. Now, watching with the help of another pair of eyes, she has come to see this behavior as what she calls "a kind of exit and entrance dance." In fact, seeing its beginnings and endings, now, not just the moment of disruption, she sees it as a logical sequence--

"it's his way of getting in and out of an activity." As a result D. sees the child in a new way: she doesn't see him "randomly falling apart" or annoying, and thus handles the episodes in a new way, too. She now sees her close observations of Jon expanding to help him and others handle various "symbolic" learning problems, as well. She writes most recently.

> "It became increasingly clear that I taught math in a way very different from anything else. Although somewhat individualized, the fact is that I do tend to get very nervous about kids not knowing math facts and then "clamp down" and become a bit of drill master. The awareness that I really treated math differently from almost everything else I taught was important in freeing me up to pursue the question of what the child (Jon, Shawn, Amber) does understand and how."

C. For another teacher, reflection is better characterized as reflection-in-action (see also Part IV). Rather than reflecting only on her own understanding (although she has done a great deal of that too), she has developed with her students a kind of community culture where active, reflective questioning concerning their mutual understandings of whatever is the business at hand, is a natural occurrence. Beginning with her own puzzling over children's questions ("What was that child <u>really</u> trying to ask me?"), she says, now of her fourth grade class, "One of the effects of the seminar for me and my kids is that there are no longer adults and kids in the classroom; there are only learners." The validity of her comment is demonstrated in her extensive log entries which include specific and full descriptions of children's questions and how she probed for their meanings, detailed accounts of episodes where children are "learning for themselves," and even quite remarkable examples of children inventing games through which one child can help others learn, for example, the principles of division.

As an expression of mutual reflection-in-action, the question, "I don't understand what you mean," or simply, "I don't get it," is a common exchange in her class. But most interestingly, the exchange is equally common from a child to the teacher, from the teacher to a child, and most impressively, from one child to another. Reflection-in-action then, has become a mutual and integral part of this little community's culture. Indeed, it seems clear that the question, "what do <u>you</u> mean?" leads quite naturally to the question, "what DO I mean?"

D. For another member of the group it is a quite different story. Reflection for her has meant gaining the courage to pay attention to what she calls her "subjective knowledge" about the children in her classroom. While she trusts and acts on these "subjective assumptions," concerning what her kids know and can do ("Timmy understands subtraction, I know that, even though he gets all the answers wrong"), others (like other teachers or administrators), she believes, only trust "objective facts." As the seminar progressed, she was pressed to reflect on <u>how</u> she gains this

"subjective knowledge," and what its content might be. At first she said, shrugging her shoulders, "I don't know, I just know." But with encouragement, she made herself a program to try and capture how and what it is she trusts and acts on. The overwhelming impression is that she recognized for the first time that it was alright for her to take her "subjective knowledge" seriously.

Clearly, reflection means something quite different for this teacher than for either of the others.This isself-reflection where the subject matter is her own practice. However, the outcome of this reflection has, most recently, taken an even more profound turn. L reports that, as she puts it, "Light finally dawned on Marblehead." Her insight is that "It's not always other people who have the right answers." She attributes her awakening, in part, to her discovery that it was alright to trust her own subjective knowledge. But she attributes it equally much to her own intimate and extended observations of the moon within the context of the seminar. These observations have, in fact, led her, over a period of a year and a half, to a series of "aha! experiences," which together account for her present remarkably sophisticated understanding of the relational movements of sun, earth and moon. She reports further that while she had taken a physical science course in college and believed she understood "how all that worked," she now realizes that those were just "objective facts" that had little meaning to her. As a result of her own observations and reflections on them, she now describes herself as having "learned things that noone can ever take away from me."

Indeed, the progression from trusting her own "subjective knowledge," to "other people don't always have the right answers," has led to her development of new knowledge which she can understand and believe in as her own. She said during the final session:

> ...and I realize that this business of thinking that there is a right answer is basically a very negative force all around for people...the reason they do things the way they do is because that's the way it's been done and somebody said that that was the right way to do it. Consequently, they don't adjust, they don't do things to try to find out how to fix the situation. I was secure in thinking that there were, you know, someone else had the right answer, 'cause then I wouldn't have to--no, it wasn't that I wouldn't have to-- the possibility of my discovering a better solution was just not--not--not even there."

And, in response to a question concerning how all this had influenced her classroom, she said, initially, "Well that's the next step, isn't it?" But then in a subsequent journal entry she writes:

> ...must the term 'teaching' not be redefined?...I may as well write this down right at the beginning so that it will be forever recorded. I can no longer teach as I

have, things must change!"

Finally, in an informal conversation over supper this same teacher commented that she had discovered that she had never been "intelligent" in her teaching, and added, "You'll understand when you see my definition of 'intelligence'--I just kept the two separate; my teaching was 'mechanical'; being intelligent was for other things-- two separate 'tracks'." In her journal we found the following:

> "Personal definition: Intelligence-- reflection of what we spend our time thinking about. It does not determine what we think about. We determine <u>it</u> by the choice we make, by what we choose to think about."

It seems clear that the teachers in Group A have learned to "practice skills of cognitive self-reflection"-- i.e., that Hypothesis 1 has been confirmed. However, the implications of this success, the factors that contributed to it, and the various forms it took among the individuals in the group remain still to be analyzed in detail. The mini case studies, above, can only give some hint of the kind of results we expect to find and the work that remains to be done.

PART III: THE ROLE OF COGNITIVE PSYCHOLOGY

In this section we will describe ways in which we have drawn upon cognitive psychology in this research. In practice, our view of cognitive psychology raises fundamental and intriguing issues which we want to pursue further.

Teachers' Questions

The questions that the teachers have raised as they have reflected on themselves as learners and as teachers, are questions that are properly the realm of cognitive psychology, but cognitive psychology has had a notoriously difficult time providing answers that teachers find useful. As the teachers phrase them, the questions are specific to their classrooms, their curricula, their own increasing knowledge, their children. Our effort has been to find how cognitive psychology can help teachers think about answers to these questions.

Here, first of all, are some of the general questions that have been central for the teachers, indications of the cognitive issues they call upon, along with examples of some specific contexts in which they occurred.

1. What is the connection between knowing something, and being able to say what you know?

   From transcript of teachers watching a child on video-tape:

   > Did he know why he did that? If you ask him why he did that, could he tell you?

   Issue: <u>Language and thought</u>.

2. What can we expect of concrete manipulatives? How do they relate to understanding?

   A teacher's comment/question:

   > My kids have worked for months with manipulatives and they still don't 'get' place value.

   Issue: <u>The role and nature of "action" in learning</u>.

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3. What is the connection between what you know already, and how you respond to a teacher's attempts to help you learn more?

From a teacher's journal:

> I wasn't ready for that question. I needed more time for my confusion.

From another teacher's journal:

> Does it <u>matter</u> what the kid is thinking about math, etc. when he/she makes mistakes? Do we use miscueing?...How?

Issue: <u>Assimilation and accomodation</u>

4. What is the significance of different speeds of learning? What can one expect of a "slow" child?

From a teacher's journal:

> I am beginning to see a shift from seeing myself as not very bright to someone who takes a fair amount of time to learn things...I have been more trusting of the fact that if I became engaged I would be able to learn important things for myself.

Issue: <u>Individual differences</u>.

5. Why is it that what we learned in school seems so straightforward but of so little use to us when there is some <u>real</u> question to be dealt with?

From a seminar transcript:

> I learned a lot about the moon in school, I passed tests on the moon...When we first started discussing the moon last year, I remember saying, 'Well, when there's no moon it's the shadow of the moon on the earth,' and then I wasn't sure, and then everything went upside down...

Issue: <u>Personal knowledge and its relationship to formal knowledge</u>.

6. What is the relationship between how a child feels and how she/he learns? What is the special status of how a child feels about herself as a learner?

From a teacher's journal:

I've never felt so 'dumb' in my life. When we first started to discuss chip trading, I understood the question, but somehow I got lost along the way. Do I understand how kids feel! I wanted to fade into the wall. I'm so upset about it I can't even write how I feel. Maybe I do not belong here?

Issue: The massive, almost virgin, territory of the relation between cognition and affect.

7. What does it mean to "know" something, anyway?

Overheard by the tape recorder, during the break:

Teacher A -did you say a couple of times ago that you didn't understand division? Well it just occurred to me that I don't understand it; I haven't looked; now I'm gonna look. It just hit me that it is the only one you do left to right.

Teacher B -Say that again?

A -Division is the only one that you do left to right.

B -Oh--huh!

A -And it just hit me--that I don't understand that.

B -You know the funny thing I've just noticed--I can't subtract any more. I can't subtract with re-grouping any more in my check book.

A -What do you do?

B -I just can never figure out whether it should be in 9's, whether I should be adding 9's or whether I should be adding 10's, and I always have to...I don't trust anything unless I check it by adding up.

A -Yeah.

B -And I just really don't know--I always knew. I never had any trouble, and now I...

A -The more you teach, the more you think about it, the harder it really is.

Issue: The epistemological foundation of psychology.

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Two Levels of Learning

Given the particular nature of the seminar, all of these issues are addressed on two levels. At one level, the teachers are learning about the moon, about making melodies, about long division, about measuring time. At this level, the primary experience is watching the moon, building tunes with the bells, and the pertinent fields of knowledge can be thought of as astronomy, music, mathematics, and so on. At another level, the teachers are learning about learning. At this level, the primary experience is watching people learning--themselves, each other, and children--and the pertinent field of knowledge can be thought of as psychology.

This two-level approach makes an important statement about the ways that we have drawn upon current work in cognitive psychology, and the ways we see cognitive psychology contribuitng to teacher education.

Just as it seems clear to us--and the data confirms this--that the math, science, musical knowledge that people construct for themselves over time is more accessible to them than knowledge that they "receive" formally, so it seems clear to us that the same must hold true of knowledge about learning. That is, rather than being taught <u>about</u> psychology (rather than being taught <u>about</u> music theory), what needs to be done is to provide experiences that challenge teachers' knowledge about learning. Just like the experiences which challenge their knowledge about math or science, these can push them to think about it more deeply, to take into account features they might have missed, and so on.

Our question was, is it possible to help teachers learn cognitive psychology in such a way that it will be of some help to them in their teaching? This does <u>not</u> mean teaching textbook versions of cognitive psychology, any more than helping people learn music means teaching

textbook versions of music theory. It means trying to help them make new sense of their own experiences as learners and teachers.

Again, just as we have drawn upon our own knowledge of astronomy, music, or mathematics, to set up productive experiences in those areas, so have we drawn upon our own knowledge of psychology, to set up experiences in this area.

At both levels, the seminar is characterized by careful interventions on the part of the staff, and eventually on the part of the teachers among themselves, as well. Interventions are guided by an on-going interaction between the participants' particular, expressed thoughts and our sense of what they might be thinking. Thus, as in the "clinical interview," interventions are always constructed on-the-spot in response to observations and accounts made by the participants. But, in the context of the seminar, these on-going interventions may themselves evolve over a long period. We are talking about personal theories that we all depend on for finding coherence in the world. To shake them up, even to give them up, demands courage and care. (See, for example, Part IV, p. .)

It is in clinical interventions that the methodology of the seminar and its research diverges, perhaps most strikingly, from more traditional methodology of psychological research. At the same time, it is through these, as examples, and through discussion and reflection on them, that cognitive research gains most specific relevance to the classroom. On one level the teachers learned both to question and to trust their own experience as learners; and as a result, on another level, in their work with children, they shifted from seeking and valuing "right answers" to valuing the capacity to seek out ways in which what a child says or does makes sense to himself and to others.

An Exam[illegible]

There follows one expanded example of the use of our own knowledge of cognitive psych[illegible] in providing an experience to stimulate the teachers to think further about these issues. This example focuses on Piaget--for teachers, perhaps the most frustrating work in cognitive psychology since it seems as if it should be helpful, but it isn't. [illegible] As one on-looker has said, "It aren't [illegible] what you're teaching them to [illegible] to understand [illegible] of a situation; to prove their thinking.

We have attempted no systematic presentation of Piaget's theory or findings. We have not applied his stage-designation in protocol analysis, or in interpreting individual children in the teachers' classes. Our only explicit reference to Piaget has been to demonstrate clinical interviews of children working on classic Piaget problems.

In our interpretation of Piaget, these problems are not intended and cannot well be used to pin-point any one child's level. Indeed, this is not Piaget's own purpose, either. Rather his goal is to trace the genetic epistemology of a notion, and to do this he bases his conclusions on a whole set of protocols. However, it is the good fortune of educators that his clinical method, and the problems he poses to children, are wonderful probes for revealing a child's thinking in ways at once richer and less precise than the assignation of a substage.

The first time we did such clinical interviews, the teachers' reactions were, from one point of view, similar to the reactions of other groups who have watched such demonstrations: [illegible] with the children's involvement and spontaneity, and their [illegible]

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think hard about difficult problems. They noticed that the emphasis was on what the children were thinking, not on its rightness or wrongness. They noticed the effort put into finding a way to ask a question that does not at the same time tell its answer. They noticed that the adult is often silent--and that the silence is productive. They saw examples of how weak data is in the face of a strong conviction, and how children "really do" think things as Piaget has described. But, at the same time, it was clear that there was also something that hadn't worked with this group.

On reflection afterwards, the staff realized that this demonstration was out of step with the usual pace of the seminar: the general points were made, but for this group there was a sense of an embarrassment of riches--far too much to take in and give its due. For example, 4 different children had worked with five different problems in contrast to our usual mode of spending sometimes 2 or 3 hours on one problem or one child's work.

The second time we invited children to the seminar we took a different approach. We worked with 2 children who were friends, and enjoyed making this excursion together. The children worked at the same time on just one problem. Further, Duckworth, who was doing the demonstration, undertook to stop at the end of this one problem in order to discuss with the group what had happened, before going on to anything else.

This approach was far more attuned to the pace of this group of teachers who were accustomed to taking an experience part, considering it from every angle, and raising questions about its various kinds of significance. This time, moreover, we never got to a second problem. There was so much already that the teachers wanted to pursue.

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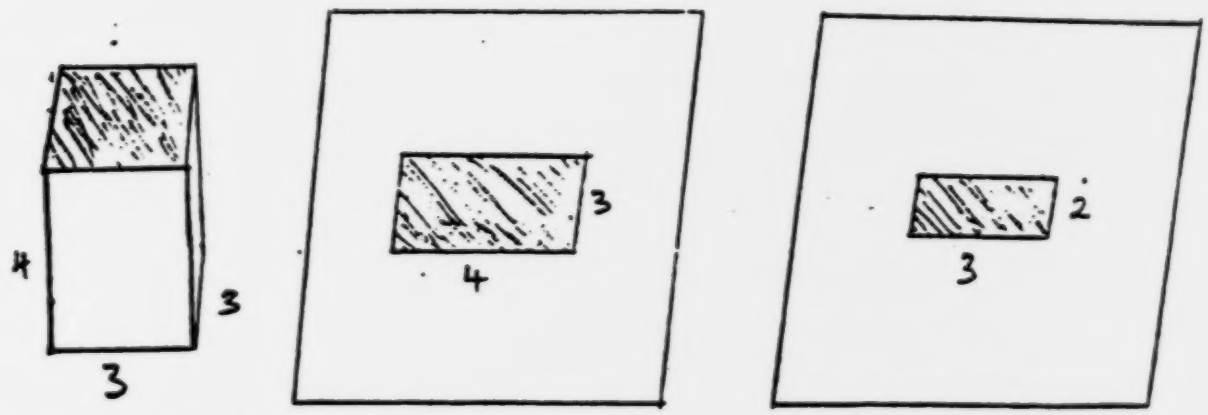
The problem was a classic from The Child's Conception of Geometry (1960) known as "The Islands." In its classic form, the child is presented with a solid wooden block, 4" high and 3" X 3" cross-section (see Figure 1); a pile of small (1") wooden cubes; and a blue board (meant to be a lake) on which there are three patches of cardboard (meant to be islands) -- one 4" X 3", one 3" X 1", and one 2" X 2". The child is told that the solid block is an apartment building; that everyone has to leave that building, and the child is to build to accommodate the occupants on one of the "islands." The base of the new building is to cover the entire island, but it can't go off into the water. The new building has to have just as much room in it as the original one.

Piaget outlines, of course, three stages, each with two substages. It is not necessary here to repeat his outline. Consistent with our approach, Duckworth used the problem to explore the thinking of these two children, as far as possible. This entailed keeping in mind the basic question inherent in the task, a variety of possible responses, and most important, engaging in an interesting intellectual discussion with the children.

In this particular case, each child had his own "lake," and one "island," Timmy's being 4 X 3, and Sandy's 3 X 2.



Model Block Timmy's "Island" Sandy's "Island"

Figure 1

Sandy built his building one layer higher than the model-- 5 layers on a 3 X 2 base; then moved the model over beside his building,

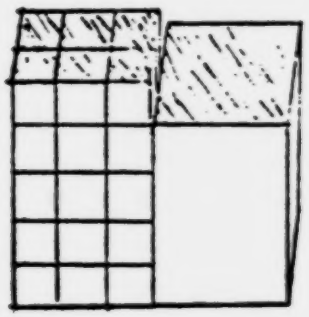


Figure 2

and took off a layer--so they would be the same height. He recognized that he now had less room in it, but couldn't immediately see what to do about that without building out into the water. Timmy suggested building it higher; Sandy thought it was a good idea, and added two layers.

Timmy also stopped when his building was the same height as the model (Figure 3)

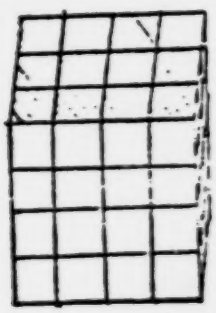


Figure 3

and, while acknowledging that his had a little more room in it (note that it is on a larger base) neither of the boys could see what to do about it other than cutting out a patch of cardboard to make an island the same size base as the model, and starting again.

"What if you took off some like that?" Duckworth asked, removing just three cubes, i.e., part of one layer. (Figure 4) "It would goof up the whole thing,"

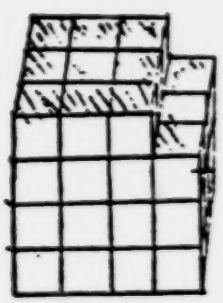


Figure 4

said Timmy; "It's just a little smaller, that's all," said Sandy. Duckworth responded to Timmy's "goofing up" objection by removing the rest of the layer. (Figure 5) Neither of them found that an acceptable solution. After repeated

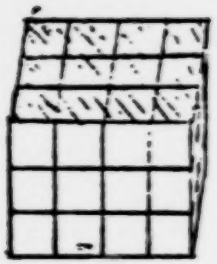


Figure 5

suggestions from them -- to cut a new base, or to add more clay to the model--, Duckworth said, "All you can do is take more blocks off or put more blocks on," Timmy said. "You'd have to get thinner blocks."

Duckworth then made a suggestion -- to see how the children reacted to it. She turned the model on its side, so that it was on a base identical to Timmy's (Figure 6). With surprise and pleasure, the boys responded that the 2 buildings

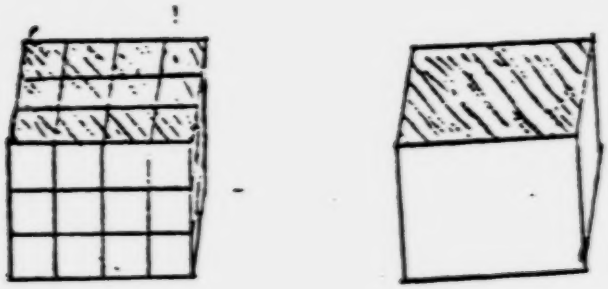


Figure 6

were now "equal".

Duckworth- "So that, you think, is equal, do you?"

Timmy- "Yeah."

Sandy nods.

Duckworth turns it upright again (Figure 7) - "Now what do you think?"

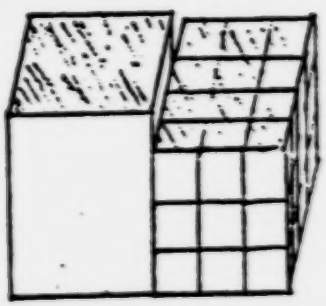


Figure 7

Timmy- "Now you have to put more on."

Timmy explains this for a while, but does not in fact do it, and then Duckworth asks, "Has one of them got more room in it than the other?"

Timmy- "Yup."

Duckworth- "Which one?"

Timmy- "This one right now." (The model)

Duckworth- "Why do you say that?"

Timmy- "No I think they have the equal amount of...." (mumbles)

Duckworth- "Pardon?"

Timmy- "Because this one's bigger (model) and this one's wider (his)"

He then proceeds to measure (with his fingers, not with a block, but still....!) to see by how much the one is "bigger" (higher), and by how much the other is wider.

Timmy- "The same width up and the side" (That is, the model is taller by the same amount as his building is wider.)

Duckworth- "The same width? Is it?"

Timmy- "Yup, I just measured it, and they both came out the same way."

His procedure convinces Sandy, to whose building attention now turns.

After an initial tendency to want Sandy's building to be the same height as the model again, they settled on having one extra layer. (See Figure 2.) This time Sandy measured with the blocks, to show that one layer was missing in width, and thus one layer needed to be added on top.

Their solutions, then, were -- a 3-layered building on Timmy's 4 X 3 base, (correct) and a 5-layered building on Sandy's 3 X 2 base (1 layer too short).

Duckworth probes some more, makes same counter suggestions, they stick with their solutions, and she stops there.

Her interpretation was that both boys were drawn to judge the overall amount of space by the most salient dimension, the height; that they were able to think how to remedy it in one case (Sandy's, when they had to build higher) but not in the other (Timmy's, when they had to take off a layer); that they then saw that a greater size in dimension (height, say) could be compensated for by a smaller size in another (width, say); in both cases they judged that it needed not only to be higher (or wider) but the same amount higher (or wider); this worked in one case (Tommy's) but not the other (Sandy's) -- indicating that "the same amount" applied to a single dimension, and not to a 3-dimensional slice; that there was no tendency to think of the original solid block as composed of units whose number could be calculated.

Piaget's interest in this problem concerns the epistemology of the notion of volume. Of the kind of work Sandy and Timmy did, for example, he says:

> "In all these trends, there is growth in the articulation of Euclidean intuitions of volume. It is through that increasing articulation that notions of volume lose their topological character and come to conform with Euclidean notions of length and area which are elaborated at this level. However, although these articulations pave the way for operational handling of the various relations together with their logical multiplication, they are insufficient to enable children to effect those reversible compositions which mark the operational level proper. Thus these responses are intermediate in character, and this fact appears most clearly in the answers given to our questions about conservation." (Piaget & Inhelder, 1967, p. 369.)

Now this takes some effort to understand; and moreover, it takes a far broader context -- references are made to notions that have been studied and subsequently discussed through two entire volumes.* It is not a criticism of Piaget to point out that the quoted discussion is not easy to grasp if one has not read the rest of the volume, and if one is not concerned with those epistemological issues. But the fortunate thing is that this kind of work with children has other values which are directly useful to teachers as they work with children. The main thing -- common to Piaget's interests, as well, is the focus on the way children are making their own sense of the situation in their own way. We can all appreciate, and even be awed by, watching this happen without putting our emphasis on Piaget's interpretation of what is meant by "in their own way."

That points to a second difference between Piaget's own writing and other uses of his problems. In reading Piaget's protocols it is difficult to be "awed" by children's intellectual work. Indeed, it is very difficult to read them at all -- to follow the steps in what the children do and say -- and certainly to come to our own conclusions about what they mean. And most importantly, it is simply not possible at all to read into Piaget's brief protocols what is actually entailed for the child as he does the work -- the surprise, puzzlement, dogged pursuit,

* Piaget and Inhelder (1960, 67).

resistance to suggestion or not, doubts, conviction and so on.....all of which gives us an appreciation of a mind at work. It was all of these aspects of the session with the children, not to mention gestures, facial expressions, and eye movements, that contribute to the teachers' understanding of Timmy's and Sandy's thinking.

The important thing for the teachers, then, was seeing how children could become caught up in intellectual work, how they could engage with an adult in intellectual discussion, and how different this is from an adult's attempts to teach them to see it in a certain way. Piaget's contribution here is, on the one hand, having located what are essentially crucial intellectual issues for children, and finding ways to put the issues in a form that catches their interest; and on the other hand, developing the "clinical interview" technique in which the adult role is to find out as much as possible about what the child himself believes about an issue. Both these aspects are what gave the session with Timmy and Sandy its significance. Piaget's own interpretation was, in this case, beside the point.

It is clear that the teachers did seize the basic nature of the question. Duckworth stopped at the end of what is thought of as one part of the classic technique.

The teachers discussed at length what had happened, and came up with three further questions that they wanted the children to think about and respond to. Despite the fact that none of the teachers had read any of Piaget's books, all three of these questions turned out to be ones that Piaget had asked in other parts of his exploration of children's notions of volume - evidence enough that the teachers had seized the crux of the problem (and were, in their invention of further questions, "being" Piaget):

> "What would happen if you took the model away and asked the kids if the two (Timmy and Sandy's buildings) have the same number of rooms?"
>
> "I would just like to see them build a copy of the model, without talking about islands."
>
> "What if you asked them: if you only had this many blocks (the blocks in Timmy's building) could you build that one (Sandy's)?"

These three questions were then pursued, very productively. In answer to the first question, Timmy replies, "If both our buildings fit that building, the clay building, then both of ours would be the same." Sandy agrees. (The question comes back later, however.)

The most intriguing episode of all arose when they were asked to reproduce the model. For each of them, it was a problem to make the base, though each of them resolved that problem without undue perplexity. (One of them held the model just off the table, and built a base of blocks under it -- as if he were constructing with the blocks the patch of cardboard similar to the other "islands".) Once the base was established, both proceeded easily. Sandy finished his first, and Timmy was left without enough blocks to finish. He had 2 complete layers, and 5 blocks on the third layer; he needed 4 more to complete that layer, and 9 for the top layer (Figure 8). Duckworth asked him how many blocks he needs.

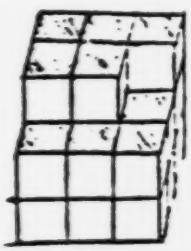


Figure 8

Timmy- "About 10."

Duckworth- "How did you figure that?"

Timmy counts, and then announces- "9 more."

Sandy is persuaded (with difficulty!) to lend Timmy 9 from his own building. As Timmy adds them to his, it becomes clear that there aren't enough. Tommy is dumbfounded.

Duckworth- "Odd, eh? How many more do you need now?"

Timmy counts- "Four."

The 9 blocks are given back to Sandy, and Duckworth tries to move on to another question, but Timmy is still totally taken up with the mystery of the 9 blocks.

Timmy- "I counted wrong."

Duckworth- "How did you count wrong?"

Timmy- "I didn't have these on when I counted." (he takes off the 5 of the third layer.)

Duckworth- "What happened?"

Timmy- "You musta took some."

Duckworth- "How many now do you think you need?"

Timmy- (Counts 4 missing from 3rd layer, 5 present in 3rd layer, and 3 more, it's unclear from where.) "Twelve."

Duckworth- "How'd you get 12?"

Timmy- "I went 1 2 3 4 5, (the 5 present) 6 7 8 9," (the 4 missing)...

"I still need 9!"

Sandy- "Timmy, if you get 4 more blocks, and then another 9 there, it would probably be just like mine."

Sandy gets surer and surer of this; figures out that would make 13; and tries several times to explain it to Timmy. For much of the time, Timmy is still trying to count. For example

Timmy- "Wait a sec, 1 2 3, I have 4 here, right? I mean 5, I count one more layer 1 2 3 4 5" (Sandy- "But you said...") "Wait--5 6 7 8 9 10. Wait a minute I have 5 here, and then I need 5 more on the top and then I need s..s...and then I need 5 more, 6 7 8 9...oh wow."

Sandy finally manages to explain his way of going about it; takes 13 blocks from his building and adds them to Timmy's while Timmy counts. When they have all been added, Timmy brings over the clay model, to check that this building is just like it. "Yup," he says.

Duckworth drops it there.

They go on then to calculating the number of blocks that are in each building, and although that was full of interest, our purposes here are better served by looking at the teachers' discussion of "the 13 problem." The first teacher to bring it up said:

T_1- "He didn't have a good system for counting--he would count the ones he had, and then say these were the ones he needed.

Another teacher responds that she thinks he did have one part of a very good system.

T_2- "But that makes--if you have 5 and those 5 are raised and you know you need another layer, then you need at least those 5. Right? You know what I mean?"

T_1- "Yeah, I'm with you."

T_2- "Alright--so I thought--that was a strategy that would have worked, if he had extended the bottom layer--I mean if he had doubled, then the spaces...

T_1- "...doubled the bottom."

T_2- "...you know,...then he'd drop that and forget that he needed to move that up. It wasn't until the end that I could see that counting strategy."

Two teachers said they thought he asked for 9 because he knew he needed one more layer; one of them thought he then forgot about the four missing in layer 3; the other thought he simply didn't know how to take them into account.

T_5 disagrees- "Sandy would say 'you need 4 more for this layer,' and (Timmy) would say, 'no, I need 5 more for this layer'--so he was talking about different layers."

T_6- "When I was watching him count, he seemed to be counting the 4 empty spaces and then the 5 that were up--And it was as if... he knew he had to reach a 4th layer, and in order to reach a 4th layer, he had to count more on the 5 that were up, and he also was realizing that if he counted 4 more in the spaces he would have a flat layer and I think he was confusing like the flat layer with the top layer."

T_7- "I felt like he understood that he had to go up another layer and so he counted 5 on top and then somehow when he counted the 4 he was filling in the spaces but then he couldn't also fill in the spaces again."

One teacher had the impression that Timmy knew that one layer consisted of 9 blocks, and referred to the way he had built his 3 x 3 base. Others disagreed on that point, and cited other evidence.

T_6- "I'm not sure he realized--I'm not sure I realize...that the 5 that were up and the 4 that were spaces, together form 1 layer. Because they're not--I mean, I don't think he was seeing the 5 and the 4 as part of a whole layer. Some were up and some were down."

These excerpts show at least 4 of the different interpretations the teachers made of what most teachers would simply think of as a "mistake."

This discussion would do credit to a graduate seminar in cognitive research. The questions were good ones and the evidence invoked in support of possible answers was good also: did Timmy know that part of what he needed was a complete layer? Did he know that adding together the number present and the number absent made a whole layer? Did he know there were

9 in a layer? Even more subtle are the three interpretations of how Timmy might have come to add together some blocks that were present and some blocks that were absent in trying to determine how many he needed (T_1, T_6, T_7).

But the teachers did not see this as an exercise in psychology. Rather it was as teachers that they wanted to make sense of what the children were doing. It was as teachers that they realized that the better they could judge how children were seeing a problem, the better they could decide what would be appropriate to do next.

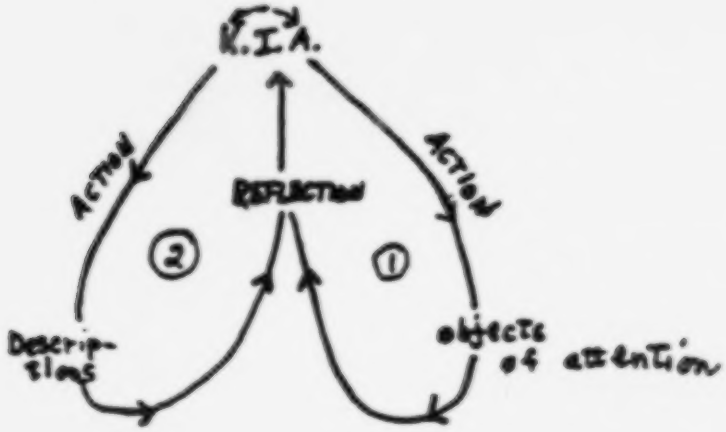
This demonstration was the context for the second session described in mini-case-study A (see Part II, pp. 9 to 11). Looking back at the teacher's comments on p.11, it is clear that the demonstration and the discussion that followed did indeed have explicit significance for her as a teacher: "...I feel closer to changing the vested interest in my objectives--or at least believing that that process alone is valuable. I guess for the first time clearly I saw children learning--the process of learning without the answers fully in tact. Ah, so many times around on this issue." Indeed, it seems unlikely that this demonstration would have had this kind of impact on this teacher without "...so many times around on this issue," in their own reflective learning in the previous seminar. It also seems unlikely that learning about Piaget in a more traditional context would have led to such insights concerning the teachers' own work with children in her classroom. We have, then, some examples of the evidence in support of the effectiveness of our two-level approach to cognitive reasearch. It is this approach and the preliminary results which one observer has described as "revolutionary."

PART IV: MUSIC -- ANALYSIS OF A PROTOCOL

In the original proposal (pp. 14-15) it was anticipated that music would play a special role in encouraging teachers to confront their "intuitive knowledge" — It was also predicted that music tasks would "suggest experiments" in other domains (p. 9). While some of the other predictions with respect to music were not confirmed (see below), this one was. In fact, the initial music tasks did lead, quite spontaneously to other projects involving for example, building "machines" to measure time, experimenting with balls rolling down ramps, and other experiments involving time, space, motion, their relations and their measurement. In turn, the music tasks did encourage the teachers' interest in and awareness of problems of description, especially the possibility of making differing descriptions of the "same" thing. And when the phenomena to be described involved relations of relations (as they often did), these proved to be the most intriguing and also the most puzzling.

At the same time, the staff, as informed observers, gained new insight into the underlying, tacit theories which characterized the participants' knowledge-in-action (see below). However, interestingly, our insights related to music, unlike those in physics or math, were often difficult to use as a way of helping teachers to recognize, understand and appreciate their own musical know-how. Not surprisingly, then, the teachers varied widely in their reactions to the music tasks. At the extremes, one teacher found that they were the most useful activities she did; for another, it remained perplexing why we had done them at all.

A Framework for Protocol Analysis



The diagram above is an attempt to organize in a systematic way our efforts to probe and make sense of reflective learning in the course of the teacher's work within particular concrete task situations we designed for them. Because we wanted to capture the dynamic quality of these experiences, we have made use of notions which emphasize the dialectical relations among actions — e.g., actions on objects, reflection-in-action, reflection-on-actions, and knowledge-in-action (KIA).* The term, knowledge-in-action, which is central to the model, we have tentatively characterized as the current (but not necessarily stable) state of an individual's possible mental constructions and coherence-making strategies with respect to some present phenomena. We use the term in place of more traditional expressions like "mental structures", "internal representation", or "cognitive schema" in order to capture a sense of movement associated with learning or change. We would also like to suggest with the term, that such "knowledge" need not be associated with a capacity for external symbolic expression. Thus KIA may often be that which an individual knows how to do, but can't say.

* The term, "reflection-in-action", is D.A. Schön's; indeed, the model owes much to his use of the idea in The Reflective Practitioner (in preparation).

In the diagram, above, the arrows marking Loop 1 indicate that KIA shapes the way an individual acts on or manipulates objects associated with a particular task. The continuation of Loop 1, as it passes through REFLECTION, indicates that an actor's reflective apprehension of the effect of these actions can influence the current state of her KIA. This process, in turn, may lead to new actions on the objects.

We can say, then, that the manipulation of objects in a task situation is an initial experiment. The result of this experiment (an arrangement or grouping) is an externalizing of the individual's KIA in a kind of "acted description" within the materials themselves. The result of the acted description, especially if it is surprising, leads, through on-the-spot reflection, to new actions— a new arrangement, ordering or otherwise shaping of the material at hand. This on-the-spot reflection in response to an acted description we call reflection-in-action.

For example, as Tommy and Randy constructed and reconstructed their buildings (see Part III, above), they were externalizing in acted descriptions their KIA with respect to the problem as they saw it. And as they looked at the results of these acted descriptions, they were sometimes surprised. The materials then "talked back" to them, influencing the current state of their KIA which led to new actions on the objects.

The arrows in Loop 2 of the diagram refer to actions of description which externalize KIA in media other than the materials themselves — e.g., verbal or graphic descriptions. These acts of description, like those in Loop 1, are guided by KIA with respect to the particular problem-domain and also by KIA with respect to verbal or graphic description-making. The continuation of Loop 2 as it, too, passes through REFLECTION, suggests that the making of verbal or graphic descriptions may, through reflective

apprehension, also influence the current state of KIA. This may result sometimes in a new view —for example, to seeing new elements and relations or even to seeing the whole problem in a new way. Such shifts or restructuring of KIA can lead once more to new actions on the objects — i.e., to changes in the course of Loop 1 — or to new descriptions.

Thus, there is a dialectical process occuring within Loop 1, a dialectical process occuring within Loop 2, and also a dialectical process occuring across Loops 1 and 2 — i.e., between actions on objects and acts of description in a medium other than the materials, themselves. Central to this picture, then, is the notion that KIA, an individual's dynamic state of possible mental constructions and coherence-making strategies, is reciprocally influencing and being influenced by actions on things and by acts of description in verbal or graphic media.

For example, Duckworth's questions (What happened? How did you get 12?) elicited verbal descriptions from the boys. As they reflected on their actions through the resulting verbal account, this sometimes led them to try something else — i.e., to change their acted descriptions. Reflection-on- action — a "stop-and-think" — most typically occurs, in this process, only when reflection-in-action reaches an impass or is probed by an outsider. Reflection, as reflective apprehension, then, is an intrinsic mediating force in this process.*

Our terminology brings to mind Piaget's notion of "reflective abstraction". Our use differs from Piaget's, however, in the emphasis and role we give to

*This account does not distinguish sufficiently between reflection, as in "objects talk back" (or as in a glass reflecting), and reflection as in re-viewing (or as in looking at the glass). However, the ambiguity seems unavoidable in the effort to convey that the reflective process, here, is not simply one of standing back or removing oneself, but rather one that is closely tied to action, itself.

description. Indeed, this emphasis was already suggested in the original proposal, especially in the discussion of the role of music in the project (pp. 14-16), and the discussion of the uses of curriculum materials (pp. 16-19). The emphasis there was primarily on the pervasive influence of conventional descriptions or "privileged languages" on what is considered "knowledge" or mastery of some "basic skill". That is, the grasp of elements and relations implicit in the symbol systems associated with a domain is often taken to be equivalent to "knowledge" in the domain. In the framework proposed by the diagram we can, instead, contrast the participant who has "formal knowledge" within a domain (e.g., one who has learned the "privileged language") with the novice participant by attending explicitly to the differences expressed in Loop 2 and to their influence on the actions of Loop 1.

AN EXAMPLE: TUNE BUILDING

The example which follows will serve to illustrate how the proposed model can be used as a framework for protocol analysis. The task in this instance is, in fact, one involving music. The analysis will demonstrate the kinds of procedures we are using and would propose to develop further.

The task as given to the group was as follows: 1) make up a tune that you like, using all the (Montessori) bells in the collection you have been given;* 2) make as rich a description as possible of your completed tune; 3) write a set of instructions so someone else could play your tune on your bells.

In preparation for this music task, the group was divided into pairs.

*Montessori designed a set of bells to be used as one of the "sensorial materials". The bells are "tuned" to include all the chromatic pitches over one octave (C to C'). The tuning results from differences in the thickness of the metal and thus, for the player, they all look the same. As a result, differences in pitch are only distinguishable by actually [illegible] the bells.

Each pair of participants was given a set of five Montessori bells. The bells were selected beforehand so as to include pitches that did not obviously belong to any one major scale — i.e., did not clearly generate one, single major key or unambiguous tonal center. It was hypothesized in designing the task that all the participants would need to confront that issue in some way, thus confirming a more general hypothesis: the pitch relations which generate tonality are necessary factors in our internalized model of a coherent tune.

The specific behavior that would constitute evidence in confirmation of these hypotheses was not predicted. Indeed, the questions were, first, could we observe sufficiently consistent behavior in the decisions and constructions the participants made so as to confirm or disconfirm our hypotheses; and second, could the players describe their tune in terms that would demonstrate in some way their sense of tonality as a necessary factor in its coherence? In addition, it would be important to compare these spontaneous descriptions and their implicit units of analysis, with the categories of analysis implicit in the conventional languages and notations associated with music theory.

In this regard the protocol presents an interesting problem: In order for us as observers to understand what the players did and, indeed, to tell the reader what they did, it is necessary before-hand to know the names of the bell-pitches we gave the players to work with. But if we say that the array of bells included the pitches, D $E^{\flat}$ G F♯ C, as they did, we as observers as well as the reader, are privy to information that the players were not. More importantly, this information is quite different in kind from that of the tune builders as they began their work.

For example, let us assume that the informed observer/reader has

acquired and internalized a reference structure which gives meaning to the symbols associated with the task domain. The reference structure assumes at the very least, the fixed, linear, and equidistant ordering of pitches — i.e., the set of all available pitches ordered from low to high.

Given, then, the names of the bells-pitches, above, we can put them in order (D E^{b} F# ...). The pitch names thus designate particular and unique places within the reference structure and also specify the distances between any two pitches — i.e., their intervalic relations. Further, the reference structure assigns possible functions for these pitches within a tonal network — e.g., tonic, dominant; do, sol; 1,5. A reference structure, then, is an internalized mental construct in terms of which symbols and names gain meaning. Indeed, the reference structure, mediated by the associated symbol system, strongly determines what things and relations we assume as givens in a particular task domain.

Recall, now, that the players had before them a mixed array of bells that were not named or labeled in any way, and which looked identical. Thus, the only way the participants could distinguish one bell from another was to play them. Further, the musically novice tune builders did not have an internalized reference structure within which they could place the bell-pitches, measure their distances or assign names to them. Thus, unlike the informed observers/readers, the players were in a position of having to find out by actively experimenting with various combinations and arrangements of the bells, just what it was they had. Indeed, much of their initial work was spent in the construction and re-construction of what we will call a reference entity — an "ordering" of the bells through which they could hold onto the coherence-making relations they found in these experiments. This reference entity served to externalize the elements and relations the

tune-builders found and it also determined a subsequent notation scheme. The process of construction and the resulting reference entity are, then, quite different in kind and in function from an already acquired reference structure with which the observer/reader comes to the task.

- a reference entity is unique to this task
- it exists as a construction made up of a set of objects, not as a mental construct
- it functions as a way of "holding still" found relations
- it evolves over time as a result of active experiment where each move becomes the basis for and entrains the next
- it serves to define the very terms of the task which only gradually emerge through reflective interaction between player and materials

But this is not to say that the participants came to the task without mental structures for making action experiments and decisions. Indeed, it is our expressed purpose, here, to understand the nature of their KIA as this quite explicitly shaped their decisions, their acted descriptions and the evolution of their final tune.

To return to our initial point, then, giving the reader the names of the bell-pitches, with the meanings they carry in an already thoroughly internalized reference structure, puts us in danger of reading back onto the participants' moves — their decisions and actions -- "givens" which are ours but not theirs. At the same time we run the risk of failing to recognize and to appreciate what is is the participants can do. And with this we may also fail to appreciate the cognitive work involved in their construction of a reference entity on-the-spot, in their tune-building decisions, and in their invention of a notation scheme for describing their tune.

The reader should bear in mind, then, that the analysis which follows is doomed to distort the players' experience. To correct this distortion, try to imagine the situation as one in which pitches have no names and that you have no pre-determined way to assign them. And if you ask yourself how, then, you might go about finding some basis for constructing some kind of reference entity that would reflect the sense you are able to make of what you hear, you will be assuming something like the stance of our participants.

Analysis of the protocol

In this section we will analyze excerpts from a rather long protocol in which two of the teachers, we will call them Dora and Ann, are involved in this experiment in tune building. Dora's first comment serves as a striking example of the necessary interaction between actions on objects (the bells), acts of description, and the process of constructing the "givens" of the task. After playing all the bells, briefly, Dora says,

> Well, we have to make a tune. Should we make a symbol system to sort of designate the bells, or should we put them in order?

Dora proposes two apparently alternative tasks as ways of getting started on their tune-building. But, in fact, the first task is dependent on the second. That is, to "make a symbol system ... to designate the bells" requires that the players first find some way to "put them in order". In short, the players must construct an acted description within the medium of the bells, to which a subsequent "symbol system" will refer. They must, then, build a "reference entity" which will determine their subsequent notation scheme.

Thus, for the teachers with their minimal musical training, the work Dora proposes — to order the bells, is, in fact a process of searching

for the "givens" of the material. That this involved reflection-in-action is evidenced by the on-the-spot reconstructions they make in their reference entity and by the shifts in criteria they use in doing so. While their comments implicitly point to these criteria, it is also evident that the players, themselves, do not clearly differentiate among them.

The following criteria are expressed in their various moves: A) ordering as in a particular sequence along some explicit property— i.e., from lowest to highest pitch; B) ordering as in making the set generally coherent or making it sensible—i.e., grouping the bells - pitches that "go together" and separating these from those that are "odd"; C) ordering as in "sounds nice" — i.e., a sequence of tones that could be a reasonable tune.

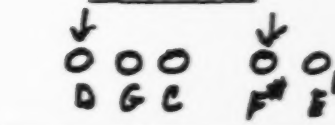
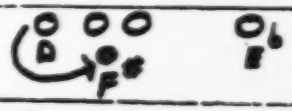
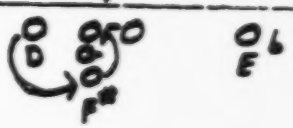
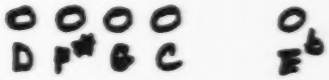
The initial events of the protocol can be grouped into four phases: Moves 5-12; 13-15; 16-22; 23-33. We have marked the boundaries of phases where there is a restructuring of the reference entity; most often this coincides with a shift in the criterion for what constitutes "in order". The bells as arranged on the table are indicated as ○ with playing on them as .

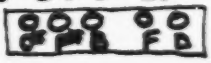
Phase 1

Moves	Arrangement	Comments	Criteria
5-7	○ ○ ○ ○ ○ D G C $F^{\sharp}$ $E^{\flat}$	D: This one ($E^{\flat}$) seems really odd, don't you think? And these three go together (D-G-C)	B
	○ ○ ○ ○ ○ D G C $F^{\sharp}$ $E^{\flat}$		
11	○ ○ ○ ○ D G C $E^{\flat}$ $F^{\sharp}$	A: These three definitely go from low to high (D-G-C)	A
12	○ ○ ○ ○ ○ $F^{\sharp}$ $E^{\flat}$	A: So, these must be sharps or flats ($E^{\flat}$ — $F^{\sharp}$)	B

In Moves 5-12 Dora and Ann construct their first reference entity using criteria A and B — ordering from low to high (A) and the search for relations that make for coherence (B). By these criteria D-G-C "definitely go from low to high" (criterion A) and they "go together" (criterion B). (Notice that their descriptions also suggest action— "go from", and "go together.") The three bells grouped together constitute the current reference entity with respect to which the E^{b} and $F^{\#}$ bells are "odd" or "sharps or flats"*. The latter bells are physically separated from the reference entity expressing their ambiguous status in a spatial way. The arrangement of the bells on the table is, then, an acted description within the medium of the task materials, themselves. It externalizes and "holds still" the relations that the tune builders have constructed so far.

Phase 2

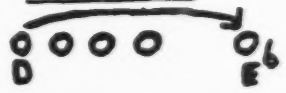
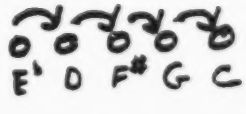
Moves	Arrangement	Comments	Criteria
13		D: Try these two together (D-F#)	-
		A. (Plays D-F#)	-
14		A. (Plays D-F#-G)	-
		D: Oh! That sounds nice!	C
15		D: (Incorporates F# in row)	C

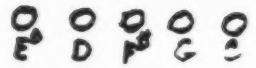
*That these pitches happen to have names that include a flat and a sharp is purely a coincidence; that they sound "odd" is not. That is, bells with the same relations as those given to the participants could have been $C^{\#}$ D F $F^{\#}$ B. In that case the analogous arrangement at Move 12 would have been:  The "odd" bells would then not be "sharps or flats" but they would still sound "odd" for the same reasons.

The acted description of phase one suggests new actions — especially how to incorporate the "odd" bells? Ann, at Dora's suggestion, tries the sequence D-F#, and then goes on with D-F#-G. Dora responds to the last try with evident pleasure — "Oh! That sounds nice!" And with this, she incorporates the F# bell into the reference entity.

Here we see reflection-in-action at work as each move evolves out of the previous move, shaping and changing the coherence of the material at hand: An experiment — trying the sequence D-F#-G— triggers a shift to criterion C, "sounds nice", as in a little tune. This shift, in turn, leads to a change in the properties Dora attributes to the material at hand. That is, while D-G-C were "in order" by criteria (A) and (B), but F# was "odd", the new context, D-F#-G evokes criterion C under which F# is no longer "odd" but "sounds nice". Then, at Move 15, Dora makes an acted description of the newly found coherence. She incorporates the F# bell into the ordering exactly in the position where it "sounded nice", externalizing and holding still the relations she has found. Thus actions on objects result, through reflective apprehension, in a restructuring of current KIA which leads, in turn, to a new acted description— i.e., a reconstruction of "in order" , or what we have called the reference entity.

Phase 3

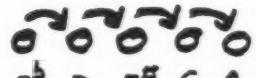
Move	Arrangement	Comments	Criteria
16		A: That's lower isn't it?	A
		D: Don't ask me about high and low; I get all mixed up.	(C?)
17-18		D: Yes! Play that. Why are we wasting time in ordering?	(A?)
19		D: Alright. So let's use them in this order ($E^{\flat}$ is incorporated into row).	A

20 

A: Or else we take out the two that sound like they're in a different key, or sharp, or whatever, and move all around them. B-C

21

D: O.K. She wants us to use all our bells so let's just keep these in this order — arbitrarily from low to high. Right? According to our ears. A-C



22

D: Right? We have an order— a description. A-B-C

Responsive, now, to the current arrangement, Ann tries, at Move 16 to incorporate the remaining bell. Reinvoking criterion (A) she compares D and E^b: "That's (E^b) lower (than D) isn't it?" Dora, apparently preferring to stay with criterion C, resists the question: "Don't ask me about low and high: it gets me all mixed up." Ann, continuing on her tack, plays the pair twice more. Dora impatiently giving in to Ann's question answers, "Yes," places the E^b bell at the left (low) end of the row and adds: "Why are we wasting time in ordering — let's use them in this order." With Ann staying close to criterion (A) and Dora reluctantly capitulating to it, the E^b- bell gains membership in the reference entity which is restructured this time more by fiat than by conviction. *

This phase ends with comments that seem to characterize the stance of each of the two participants. Ann, more careful (in the conventional sense "orderly") suggests, at Move 20, a plan perhaps for later tune-building: "... take out the two that sound like they're in a different key... and move all around them." Dora, with the taste of immediate personal satisfaction achieved almost just by chance, ignores Ann: "... so let's just keep these in this order— arbitrarily from low to high... according to our ears!" This rather remarkable statement suggests that for Dora all decisions concerning making "order" are "arbitrary"; the criterion, to order as in low to high (A)

* E^b as "lower than" D(A) seems fused, here, with a sense of E^b "going to" D as it does in the final tune (C).

is much the same sort of criterion as "sounds nice" (C). That is, they are both arbitrary "according to our ears".

The implications of Dora's comment are significant. Consider that 1) the tune-builders' actions-- judgements, moves, descriptions— are guided by what they know how to do but can't say, 2) the players are not conversant with the "privileged language" associated with the task-domain, 3) the prevailing attitude is that without knowledge of the "privileged language" one has no "knowledge" in that domain.*

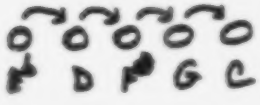
It is not surprising, then, that Dora can attribute judgements only to her "ear" and that the "ear", unlike the knowing mind, makes "arbitrary" judgements. How could they be otherwise since she cannot point to the knowledge that determined them?

Dora's comment helps to clarify the differences between knowledge-in-action characterized by an internalized reference system, and knowledge-in-action which is not. It also illustrates a central concern of the project: it is difficult, particularly in school contexts, to value or even to recognize both our own and our students' powerful capacities to construct coherence, to shape phenomena, when those capacities are embedded in every day actions but not expressable in the formal symbol systems associated with "knowledge" of subject-matter. Such KIA is most often transparent to the actions it shapes; we thus find it easy to attribute its workings to the fallible, arbitrary magic of the "ear" rather than the knowledgeable, considered work of the mind. Dora's comments towards the end of the second year (many months after this session) are a dramatic indication of how she later came to value what she called her"subjective knowledge" as a powerful tool for acquiring knowledge that "no one could take away from me." (p.16).

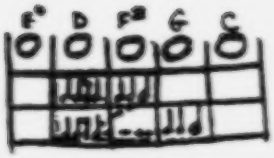
* Both players had said repeatedly before beginning the task, "I don't know anything about music."

In any case, Moves 16 to 22 provide evidence that the participants are, each in their own way, constructing a reference entity through reflection-in-action: the constructed entity is unique to the task; it is evolving from their experimenting where each move influences and entails the next through the emergence of new features and relations. While they clearly bring to the task, rather remarkable capacities for coherence-making in music, the state of this KIA is, itself, evolving "according to our ears" not according to a pre-constructed, fixed, formal reference structure. As Dora says, making clear the reflective interaction between construction and description, "We have an order—a description." And indeed the ordering is a description—an acted description of what the two participants have found so far.*

Phase 4

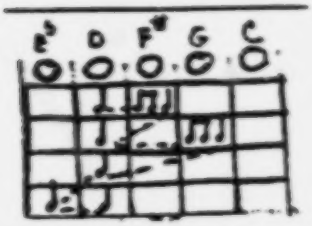
Move	Arrangement	Comments	Criteria
25		A: "We wanted these to be sort of featured. They're so different ($E^{\flat}$–$F^{\sharp}$). They start to get all muddled... we should have a definite phrase, and then a pause and then let the air clear... A line, a segment, and then a pause.	C
26			

* A more complete analysis of the protocol would need to include the underlying theories driving their KIA — e.g., a more complete account of the criteria and especially how they influence each move. For example, why do D–G–C "go together" while $E^{\flat}$ and $F^{\sharp}$ are "odd"; why, then, do D–$F^{\sharp}$–G later "sound nice"; and why, in this context, is $E^{\flat}$ found to be "lower" than D?

27* 

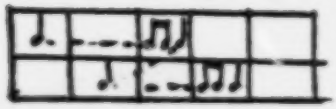
28 D: "How on earth would we ever describe that?"

D: "How do you plan to incorporate them? I mean the two odd ones... and then...?" C

30 

31

D: "Ooo! Ooo! Why don't we... keep these two together, ($E^{\flat}$-F#)... Ooo, Ooo! In other words, use these three in order, somehow (D-G-C)." (She rearranges the row putting $E^{\flat}$ and F# together on the left.) C

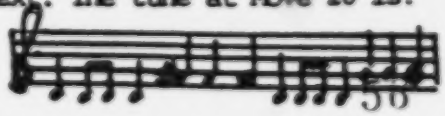
32 

33 D: "That doesn't sound too bad, right?" C

With this phase the players turn explicitly to tune-building. Criterion C becomes central as it guides the tune-builders' planning and their actions, and is reflected in the language they use. New features become focal — "phrase", "line", "segment", "pause", are structural entities of a tune in contrast to the global features of the bell-pitches which were surfaced by criteria (A) and (B).

And with this shift in focus, actions on the bells dramatically change. The reference entity becomes an <u>instrument</u>— a unique, special purpose instrument which guides the players' performance. At 27-30 Dora moves about

* We use this notation in order to try and capture the feeling of playing on the bells as they are ordered. The progression is marked by the dotted lines, i.e., read left to right within each line and top to bottom from one line to the next. The tune at Move 20 is:



on her constructed instrument, and she does so in clearly defined rhythm patterns (♩♫♪♩♫♪/♩♫♩), transforming them as she goes. Dora is improvising—perhaps the nicest example of reflection-in-action where each "go" suggests the next. But, at Move 28, Dora says, "How on earth would we ever describe that?" — reflection-<u>on</u>-action will be difficult.

At Move 31, in response to her improvising, Dora has what seems to her a new insight: "Ooo, Ooo...!" Why don't we... keep these three together... in other words, use the odd ones and keep these three in order, somehow..." Excitedly, she again restructures the reference entity <u>cum</u> instrument now in response to her new ideas. Reflection-in-action surfaces structural relations that she finds in improvising which, in turn, lead to a new basis for ordering the bells. And in this context, Ann's plan takes on meaning for Dora who simply makes it her own — description (Ann's) is transformed into actions (Dora's). The "featured bells" are placed first in the row with the three others "in order somehow" after them. The new "tone-row" becomes an acted description of the tune structure that Ann had initially proposed at Move 20.

Again playing on the bells at 33, Dora, guided by the new structure of her instrument, finds a new tune. The tune alternates between a "featured bell" (which was once considered "odd") and one of the others that "go together" (as they have from the outset): B♭–D; F♯–G. The new arrangement becomes a bell path guiding the action path of the tune's performance — a reference entity that functions as both a vehicle for and a partial description of the tune's structure.

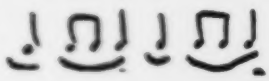
Thus the dialectic works itself out: description (a plan) gains meaning in the context of actions on the bells (improvisation), which leads to reconstruction of the reference entity (an acted description), which, in turn, entrains new actions on the bells (a new tune) that "... doesn't

sound too bad..." And interestingly, this new tune is, itself, a transformation of the very first improvisation at Move 27.

It should be pointed out, here, that all through their work, the tune builders have struggled with what we had initially hypothesized would be a problem—namely, that the given set of bells included pitches that did not unambiguously define a single tonality or key. This is exactly the issue in all the discussion of "odd" bells (or "flats or sharps" or, indeed, "in a different key.") The many times around on this issue, the work involved in resolving it, and indeed, the influence it has on the builders' construction and reconstruction of the reference entity, all dramatically confirm our more general hypothesis: a sense of tonal relations, including stable and unstable pitches, is a necessary factor in the players' internalized model of a coherent tune. Interestingly, it is in the construction of the tune that the players resolve the problem. The tune, thus far, treats the "odd bells" as embellishments to the more stable pitches (D-G-C), the latter being emphasized by repetition. The tune builders succeed in constructing and defining a tonality through the construction of a unique instrument and through the sequence of pitches and rhythms of their tune. This seems striking evidence for a significant aspect of the underlying theory which is driving their KIA-- what they know how to do but can't say.

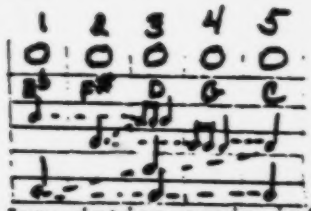
The Evolution of Description

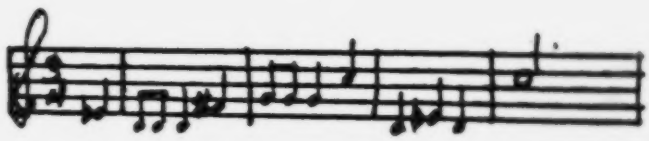
Calling the tune thus far, "the first part," the players turn, now, explicitly to description. Tapping out the rhythm, Dora invents a first description: 1 123 1 123. Dora's numbers stand for hits on the bells and the spacing and count-up indicate structured groupings of these hits. That is, she counts up the hits within little rhythmic groups:



Ann plays the tune, following the notation, and suggests they should add, "... somehow a couple more 1's" Pursuing this plan, Ann plays the tune once more from the beginning and, indeed, adds 5 more evenly spaced notes (a couple of 1's) which she improvises on their instrument:

Final Tune



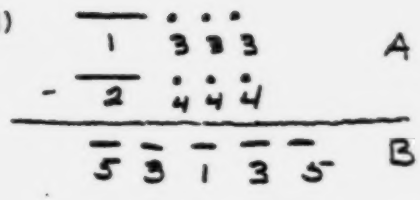


Thus, description again informs action, here, quite directly. And with this "second part" the tune is completed.

There follows, in the next long section of the tune-builders' work, a series of descriptions, each one evolving into the next, just as in the bell constructions:

Move		Description	Explanation
44	D.1)	"1 2 3 4 5" 0 0 0 0 0 (E♭ F♯ D G C)	Dora is finally ready to make a "symbol system to designate the bells." She numbers them 1-5 according to their sequence in the reference entity.
45	D.2)*	— • • • — • • • — — — — —	With numbers reserved for naming the bells, a graphic description is invented for rhythm: "...a dot for shorts; a line for longs."
46	D.3)	— • • • 1 3 3 3 — • • • 2 4 4 4 3 3 1 3 5	Names of the bells from the reference entity as they occur in the tune now, are added under the rhythm.

*While the notation of "longs and shorts", is incorrect with respect to measured values, it does capture "figural grouping". Indeed, this spontaneous example confirms findings in previous experimental situations regarding the descriptions of figural grouping in contrast to metric grouping (see Bamberger, 1980).

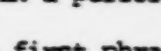
Move	Description	Explanation
60	D.4) 	The two "parts" of the tune are labeled A and B.
85	D.5) "A consists of 2 longs and 6 shorts; B, 5 longs."	The "rhythmic contents" of A and B are counted up.
94	D.6) "A is 1 long and 3 shorts, 1 long and 3 shorts; B is 5 longs... you're right."	The rhythmic pattern of A and B, as you play them to make the tune, are substituted, instead.

Descriptions 1-4 seem quite straight-forward at this juncture; but they are so only when we keep in mind the moves which led to them. In particular, the moves that led to the evolution of the unique reference entity cum instrument to which the numbers refer; and the role and evolution of description: from the earlier "odd" bells, to "sounds nice", to plans for "phrase", "line", "featured bells", up to the final graphics at D.3 and the larger structural description at D.4. It is interesting to see, also, that the initial rhythmic notation (1 123 1 123) captures grouping but not relative duration, while in D.2, the graphics do show longs and shorts.*

What about D.5 and D.6? These, in fact, resulted from a long discussion between the two players concerning"timing": once relative duration was indicated, were the "longs" twice as long as the "shorts", or were 3 "shorts" equal to one"long"; and was Part A equal in duration to Part B, and how could they tell? Finding no convincing answers to these questions, the players at D.5 simply counted up the longs and shorts — the rhythmic "contents" contained in each part of the tune.

D.5 and D.6 together surface relations between action, reflection and description in a new way. D.5 is a static description—i.e., it does not take

* See footnote p. 53 .

into account at all the sequence of events—longs and shorts— as you would play them in a performance. It's as if, given standard notation, we would say of the first phrase of America, () it contains 4 quarter notes, 1 dotted quarter note and 1 eighth note. But notice we can easily count up these contents only <u>after</u> writing it down, when we can have it all-at-once. Thus, this description of America, like D.5, is a description of a description— it tells you what you can <u>see</u> if you look <u>at</u> the graphics, not when to do what. In this instance, description reflects back giving you, perhaps, "facts", but not anything that you can use in action.*

Recognizing that such a description might be, as Ann says, "Confusing to someone trying to play the tune," Dora agrees and notes, instead, the "repeated pattern" found in D.6. Here she does capture how you go along in actually playing the tune. With D.6. then, Dora puts action back into the description—"you play 1 long, 2 shorts; 1 long; 2 shorts,; and then 5 longs."

So, we see, here, coming full circle, <u>reflection on description</u> which results, at first, in seeing the tune all-at-once, including comparison of elements which are separated in time (non-adjacent). Reflection on this static description in turn leads to recognition that, indeed, instructions need to take action into account. The description is revised to account for actions that actually occur, through time, in playing the tune.

Conclusions

It has been our intention in this analysis of excerpts from a long protocol (the whole session took over 45 minutes) to demonstrate the

* It would be intriguing, here to compare the players' notations with standard notation for the tune, as shown above, especially as this points to the assumptions built into our standard notation. However, this discussion must remain for a more complete analysis of the protocol and of the more general implications which may emerge.

the possibility of the dynamic model shown on p. 36 as a framework for probing reflective learning in a task situation. While both the model and the analysis need to be developed further, we feel, on the basis of this one worked out example, that it does surface features of problem-solving and their interactions that otherwise might go unnoticed. In particular, it helps to focus the observer's attention on the evolution of actions, constructions, and descriptions: on the extent to which each one entrains the next; and on the crucial role of reflection-in-action as it effects on-the-spot restructuring of current criteria for decision making through the dialectical processes within and across Loops 1 and 2. Further, the model helps us to give value to what the players do know how to do— i.e., it helps us to "give them reason", rather than attending simply to the "correctness" of a description or the "goodness" of a tune.

In this sense the model contributes to a kind of analysis that can be productive to teachers in classrooms, as well. While we could certainly not expect teachers to carry out such an analysis of a child's work in this detail, nor would that be appropriate, the process can provide a meta-level direction for teacher development programs. For example, as capacities for learning become more visible to those who direct teacher development programs, they can help teachers to engage these issues in their own learning. In turn, more effective means for encouraging such cognitive self-reflection on the part of teachers, can support their subsequent work with children; in particular their capacities to reflect with children on their KIA, their understandings and know-how and its possible mis-matches with the assumptions implicit in privileged languages and in the curriculum as it is taught. A number of questions still remain, just with respect to this protocol, and it is to these that our future work must turn:

Questions regarding musical cognition and adult development:

What are the implications of the distinction made between a "reference entity" and an already acquired "referencing structure"? How does the difference between them influence the interpretations of subjects' actions by an "informed observer"? For example, can such an observer avoid "seeing" in terms of the categories implicit in a learned symbol system (high-low, pitch names, etc.)? How then, can such an informed observer avoid distorting subjects' performances—i.e., avoid assuming and reading back onto the naive subject the observer's previously internalized referencing structure? How, in short, can the informed observer avoid describing the naive subjects' KIA in terms which it is not?

What further evidence is there in confirmation of the hypotheses concerning a sense of tonality as a necessary factor in the players' model of a sensible tune? Can we trace the moves which lead to resolution of tonal ambiguity? How are these and other moves related to the construction and transformations of the initial reference entity— D-G-C? What evidence is there for the subjects' distinguishing between "stable" and "unstable" pitches and how do these decisions relate to what we mean by "a sense of tonality"?

Can we trace the evolution of the players' tune with respect to specific decisions—e.g., which improvisations were accepted, which rejected; in what sense were later versions of the tune transformations of earlier versions?

Is there a consistency in the "mistakes" in the subjects' notations--e.g., a "short" when there is actually a "long" in ...? What underlies these consistent errors? What about other confusions concerning time and its measurement, and how do these relate to representations of time-space-motion in other domains?

What role did this experience play in subsequent tasks within the seminar— both in music and in other subject-matters; is there evidence that the teachers developed new understandings— how, what, were they, how were they demonstrated?

Why was it so difficult to make use of <u>our</u> insights concerning the teachers musical KIA to help them surface and develop this know-how? What does this say about the relation between the "informed teacher" and the student?

What were the differences between the two participants in this protocol— their roles, previous training, attitudes, etc.? What was the nature of the events that led to enthusiastic, pleased responses ("Ooo,Ooo!"); how were these different in content from others?

Applications to the Classroom:

What did the teachers learn about learning— their own and that of others? Is there evidence in subsequent sessions that their work on this task helped to illuminate the work of children in their classrooms?

Did the concern for description encourage the teachers to reflect on the role of description in teaching-- assumptions built into

curriculum materials, the possibilities of making multiple descriptions, the privileged status of some descriptions, etc?

Did this task and the subsequent exchange among the group help the teachers in their efforts to "give a child reason"?

PART V: THE TEACHERS IN THEIR CLASSROOMS: WHAT IS AN ANSWER?

It seems appropriate to document the interaction between the teachers' work in the seminars and their work in their classrooms, by examining what the teachers themselves have said during seminar discussions.

They have talked about changes in their professional image, changes in the way they teach, and the practical problems associated with their changing sense of the teacher's role. The opportunity to seriously consider these things with a diverse group of colleagues is an unusual one for teachers. What they have said to one another in this setting provides a rich source of information about the teachers' sense of life in classrooms and their beliefs about possibilities and purposes.

Because the teachers continued their daily work in classrooms, while at the same time reflecting on their own ways of learning and teaching in their weekly meetings, their discussions express both the connections and the tensions between reflection and action -- between thinking about teaching and doing it everyday. Therefore, the interaction of their participation in the seminar and their work in classrooms cannot be presented in the simple terms of cause and effect.

After several months of experimenting with and then examining their own ways of thinking in situations involving music, mathematics, physics and the moon, the teachers were asked to bring to the seminar examples from their classrooms of students' comments or reactions that they found particularly puzzling. The earliest examples of the teachers' attempts to make sense of what a students knows or doesn't know, and how a teacher might interact with that knowledge, came from exchanges they had with students

which occurred outside of regular curriculum activities: A student would ask a question that puzzled the teacher. She could have given (and often did give) a simple answer. But, as we began to examine these puzzling questions in the seminar, the teachers were able to delve more deeply into their students' ways of thinking. This development suggested a fundamental change in the teachers' self images. They could no longer simply think of themselves as the sources of right answers or the judges of wrong ones. Over a long period of time, this process led them to question the "absolute" nature of the knowledge contained in the standard curriculum as it was represented in books and in prescribed lesson plans.

The following examples illustrate the ongoing and complex relationship in the project between the teachers' reflections on their own knowledge and their beliefs about their role in the classroom. The teachers' comments are placed in the context of their developing use of "the clinical interview" (see p. 19) in their classrooms. Their words provide a variety of perspectives on the meaning and use of this approach to teaching.

Students' Questions and Teachers' Answers

The first example focussed on a fourth grade boy who asked, "Does Dataman* have eyes?". His teacher said, "It made me wonder if he (Lenny) can go around thinking that these computers have eyes or can see or somehow have independent thinking processes rather than being computerized... My immediate thought was that he thought it was a living thing, had eyes, was connected with a living thing." (Su) How does a teacher understand and act on her responsibility for what a student needs to know? How does

* Dataman is a hand held calculator pre-programmed with a series of arithmetic problems. The problems are displayed one by one, and Dataman "responds" to the students' answer as right or wrong.

what she knows affect the way she teaches?

Suzanne reported that her classroom aide, of whom the question was asked, "was so flattened by the idea that a fourth grader would think that Dataman could have eyes or could hear or speak, she just left it and said 'no, it doesn't.' (Su) The aide did stop to ask Lenny what had made him think that Dataman had eyes. She told Suzanne: "Len said he thought it could see because it -- 'he' -- told you whether or not your answer was right and if 'he' wasn't able to see, 'he wouldn't be able to do that!' (Su) "...

As she puzzled over the meaning of his question with the other teachers in the seminar, Suzanne revealed her distress at the thought that Lenny might actually think computers are alive. She called it a "silly" question and wondered about the boy's intelligence. "I explained to him how it worked." Dataman was "programmed", she told Lenny, so that

> all the answers were inside the machine and the machine could, when you punch in certain numbers, you have to punch in another number to get the right answer. I used a parallel and I can't remember what I used to give him a better idea of something else that was used in the same way. (Su)

Suzanne admitted that she didn't really understand how Dataman works herself. But she does know, and she said she really wanted Lenny to know, "that there was definitely not a person or a brain in there working." (Su) Lenny, when asked, said he understood "sort of", and Suzanne added, "Well, I 'sort of' understand it myself, so --" (Su) She seemed to be using her own understanding here as a standard for deciding if she had taught this student the essential thing he needed to know about Dataman.

The teachers were interested in trying to understand what question Lenny was really asking, and what might be an appropriate answer coming from

a teacher. At the same time, like Suzanne, the other teachers wondered, too, just how Dataman could, in fact, tell you whether your answer was right or wrong if it didn't somehow "see" your answer. If Lenny's question was literally, "Do computers have eyes", it was clear that they thought he should be taught that they don't. But they went on to speculate that Lenny may have been asking a question that was somewhat more complicated than the literal one: "Does it have eyes?" or "is it alive?"

One of the teachers compared Lenny's reasoning process with the way she and other adults might think about computers:

> We talk about computers as a brain with a memory and we also talk about memory being a human being's memory. The eyes are the pathway, the input to the brain. This is getting very theoretical about what this child was up to, if any of these things. But how could this thing know whether the answer was right or wrong if it didn't have eyes that saw, that led to the brain that checked whether the answer was right or wrong? (L)

This teacher, like Suzanne, was using her own way of thinking about computers to assess the legitimacy of the student's way of thinking about computers. She concluded that the student is not really "wrong" to refer to the computer as a "he", having "eyes".*

The conversation turned from attempts to understand the question to speculation about how a teacher might answer it. The teachers' proposed "answers" were also related to reflections on their own ways of learning and knowing.

One teacher in the group speculated that if one of her students had asked if Dataman had eyes,

*The group spent several sessions working with the LOGO computer music system. In fact, issues similar to Lenny's had come up during these sessions.

> maybe I'd say, 'Well, I don't think so, but let's find out.' Machines and people are an interesting topic for all of us... [taking it apart] wouldn't tell you how it works... [but] if he's thinking there are eyeballs in there, it tells him that, and if he's thinking that there's grey matter, it tells him that ... And then you get more questions, and you go find out. (Di)

This teacher admits she is not an expert on computers, but she shares the child's naive interest in how they work. For her, the role of the teacher is to take some of the mystery out of the situation. What is inside, even though she's not exactly sure of it, is familiar to her, and she wants to make it familiar to the child: "He'll go, 'Oh, wires,' and he's seen those somewhere, his father may be an electrician, or his mother." (Di)

One teacher in the group disagreed with using this kind of mutual exploration as a teaching tool.

> It would frustrate me to open it up and nothing inside would mean anything to me so it'd be more frustrating; at least when it was closed up, it was a mystery. (He)

An answer to whether or not Dataman literally has eyes or a brain seems not to be the answer she is looking for. Neither, she implies, is that the answer which would satisfy the student. She believes Lenny's question about "eyes" may really be more like the hypothesis: "If it can judge my answer then it has eyes." Once this notion is disproven, it needs to be followed by another hypothesis and so the question becomes: "Well, if there are not eyes in there, then how does the computer know whether I've given the right answer?

One imagines that this mystery would not be solved by teaching Lenny or these teachers about data processing. The essential issue for Lenny's teacher and for the other teachers in the group is that Lenny should know

that this machine is not a person. But persons also do data processing. The question of what persons do that is different from what machines do is one that is yet left unanswered at even the highest level of technical expertise about computers. The teachers started to realize that Lenny may have been asking a question of considerable significance:

> He got a machine and he picked up the essential differences between machine and man; but it's just that he wasn't sure--. (Di)

Suzanne finally said,

> I don't think of this child as being very intelligent but you're right, in that he should be thought of in that way since he did ask that kind of question; it's a higher level of thinking, if he's thinking, trying to make that distinction between robot and computer and man and whatever. (Su)

As the conversation concluded, the teachers agreed that they are often confronted with questions that are more complicated and serious than they might at first have thought. Knowing the answer to Lenny's question: "Does Dataman have eyes?" was not enough, once they began to wonder about what he was thinking and what led him to ask such a question in the first place.

This discussion illustrates the interaction between, on the one hand, the teachers' own knowledge and ways of approaching a problem, and, on the other, what they think students need to know and how they go about teaching it. This opportunity to examine their responsibilities for responding to such questions in the classroom began a long period of speculation in the seminars on the nature of children's knowledge and the role of questions and answers in developing that knowledge.

In conjunction with such speculative analysis, however, the teachers kept in mind (and reminded us of) the realities of their work. Although they recognized the complex nature of a question like "Does Dataman have eyes?", several members of the group felt that it was often impossible to

go beyond giving a simple answer to a student:

> It's part of the reality of the classroom; you just don't have time to delve. (R)
>
> So many times we just have to say 'yes' or 'no', but do we know what the child really wants to know? (Marg)

Yet whether or not the teacher has time to fully consider the meaning of a student's question, her answer may be taken as the authoritative "last word" on the subject.

The teachers had mixed feelings about being in this position of authority. While they believed that perhaps too much trust was placed in them by students, they also recognized the role such authority could play in the act of teaching. To illustrate the kinds of problems that might arise when students do not automatically "take the teacher's word for it", another fourth grade teacher recounted her experience trying to clear up a student's confusion about the eclipse that was supposed to occur during February, 1979.

Where is the Right Answer to be Found?

The student, Mario, had come to her asking for an explanation of something he had been told by his father: "My father said we didn't have whatever that thing was yesterday." The teacher responded: "The eclipse. What did your father tell you about it?" and Mario answered, "He said we didn't have it because it was snowing." (Hel)

Helen commented that just because the teacher is considered to be the final authority in the classroom, many students in her class would accept whatever answer she gave them, even if she hadn't taken the trouble to really understand their question. But Mario was an exception; he took the knowledge about the eclipse that he got from his father more seriously, than what she could tell him.

Helen recognized Mario's confusion and thought that it would be relatively simple to clear it up. But the lesson turned out to be not so simple:

> I told Mario we had it: even though it was snowing, you look behind the clouds. He walked back to his seat and about half an hour later, he said to me, 'My father doesn't lie to me, we didn't have it.' (Hel)

Helen didn't take up this conflict, but pursued her explanation of the facts. She believed that the truth of the matter could be resolved by using logic and demonstration, and therefore, it was not a matter of determining whether she or Mario's father was "lying":

> I asked him, 'Where do you think the sun is today?' and he just shrugged his shoulders. I took a book and put it in front of the window cord and asked him if he could see the cord. He said no, and I explained to him that is how it is with the sun when it is behind the clouds. And he said, 'But my father --' I concluded that he still couldn't understand it (the sun) was behind the clouds. So anyway, I didn't know what to do. His father told him there was this really big hole in the sky. Mario asked me if I had seen the diamond ring. He said his father said it would take a real big finger to fill that hole. (Hel)

Her demonstration and logic were met with more metaphorical images, which confused the situation even further. Since she assumed Mario was thinking that the sun was not "there" on a cloudy day, she also worried that he also might actually think there was a hole in the sky, surrounded by a diamond ring. Helen seems exasperated; how can she possibly straighten out this student when his father has told him all these stories about the eclipse? Her underlying concern is whether Mario knows that the sun is there, behind the clouds, on a snowy day.

Discussion of this experience in the seminar with other teachers led

Helen to wonder, among other things, what Mario had understood by her question, "Where do you think the sun is?" At the next seminar session, she reported, "I wondered how I could phrase my question to him so he will say, 'It's in the sky,' which is what I want to know if he understands." (Hel) She related that she tried out a number of phrasings on her husband, until she found one that seemed to ask just what she wanted to ask.

> So when it was a cloudy day on Friday, I said to him, 'What happened to the sun today?' And he looked at me like I was from Mars, and said, 'It's in the sky.' He must have seen the look of relief on my face because he said, 'What's the matter?' (Hel)

Helen told Mario that she had been confused by their earlier conversation and then she came back to the question of the eclipse:

> Then I said to him,'You know that eclipse we had? Did we have it here?' He said, 'Well, no. Well, I guess. Well, I'm not sure.' I said, 'I guess what I'm asking you is, did it happen, in the sky over us?' He said, 'Yah.' (Hel)

Still testing her understanding of Mario's understanding, Helen asked him some more questions and found that he was aware that it did happen, even though we couldn't see it. By "not having it" he had meant "not seeing it". She concluded:

> I must have been on such a wrong track with him. The 'where' meant: he wanted to point to 'there, there it is'. But I was thinking he didn't know it was there at all. So I was happy to find out he did, so I could go on. (Hel)

Helen's probes demonstrated to her that Mario thought she was asking him to point to the exact spot in the sky where the sun was behind the clouds, and he couldn't do that.

This incident illustrates the kind of interaction that developed between the discussions in the seminar and the teachers' everyday work in their classrooms. It is one of the earliest attempts by one of the group to use the reflective and probing techniques developing in the seminar, in an actual

exchange with a student. Helen went back to Mario to try to understand his way of thinking about the sun on a cloudy day, willing to risk presenting herself as the one who was confused. She went beyond a judgement of right or wrong to consider possible reasons for Mario's original answers. This required a change in her sense of herself as a simple authority in this matter. At the same time her interest at this point was still clearly related to teaching him the information found in the standard curriculum. It was important to Helen that Mario be correct about where the sun is on a cloudy day: "I was happy to find out he did, so I could go on." (Hel)

The sharing of such examples continued over the months, concurrently with further activities which the teachers use as a basis for examining their own understanding and ways of thinking about various matters. A solid connection was being build between knowledge and the person as knower. "What do I know?" became inextricably bound up with "How do I know" and even "Who am I?" both in the ways the teachers thought about themselves and the ways they thought about their students. The complex problems of carrying this connection into the classroom became the focus of concern. The next two examples reveal some of the possible obstructions.

Understanding and Responding to Students' Answers

One of the teachers in the seminar related the following story as an example of a situation in her kindergarten-first grade classroom when she could not figure out what a child was thinking. It further illustrates the consequences of considering the student's point of view in making judgements of right and wrong answers, and emphasizes the interaction of personal concerns with factual knowledge. This teacher is beginning to examine the practical implications of taking the student's perspective into account.

There was a new kid in the class on Wednesday. The other kids had had a one day warning. We were at meeting, first thing in the morning. For the first twenty minutes we all sit down together and the new kid was sitting next to me on the rug. They knew he was coming, so there was a lot of talk about the fact that he was there. Also, we have two boys now with the same first name.

There was a lot of that kind of energy like when people are generally nervous about what he was going to be about. And there was some talking about how many kids were in the group; whether there are twenty-three or how many.

So I said, "Well, gee, I don't know how many are here. Let's count. We are going to start with this person here." And I figured I would introduce kids as we went around. We counted out loud, everyone counting together, and we got to twenty-two, pointing to [the new member] on this side of me. So I say, "Well, some children are missing," because we used to have twenty-three and everyone knows we had twenty-three. I asked, "Who's not here?" And different children offered up the names of two kids who are absent.

"We used to have twenty-three before we had J.C., but now we have J.C. who is here today. So that means we have 22 today, but there are two people absent." That's an established fact and everybody else has it established in their head that we had twenty-two when we counted around the circle.

But Penny says, "Well, that means there are twenty-five kids in the class!" -- Angry look on her face, stormy. "I don't understand what you mean," I say. And she says, "Twenty two, you know. Twenty-two, and then L. and N., and then J.C. That means we have twenty-five."

I said, "Now wait a minute. J.C. is right here. Remember? We counted him. He was number twenty-two." She said, "Oh no. He is number twenty-five." I tried it again. Did the same thing. I was going to go around in the circle, but meanwhile, everyone, of course was off the wall: talking, chatting, they can't attend for that long.

I said something to Penny again and she got really mad and said, "You just don't understand what I mean. There are twenty-five kids in this class." I said, "You're right, I don't understand what you mean. But we can't talk about it now. And I left it. That was in the middle of the meeting. We weren't able to continue with it after the meeting.

This teacher has at least two problems on her hands: an angry child in the midst of a whole group of restless children and a child who may not know

that twenty-two plus two is twenty-four. How does she make sense of what happened? The other teachers in the seminar eagerly took up the puzzle and offered several speculations about how and why Penny might have arrived at the conclusion that there were twenty-five children in all. In this report, however, we shall focus on some of the issues that presented themselves to Diane.

Diane expressed her sense of the complexity of Penny's errors:

> It felt very much like she was angry because her understanding was disparate with not only mine, but from the given, from the understanding she has about math, which is that there are twenty-three plus one new kid makes twenty-four. She knew that that was a given and why the hell did she have twenty-five in her head? Probably I should be able to explain that. (Di)

Diane related to the group what had been her on-the-spot understanding of Penny's error and of her responsibility as Penny's teacher:

> Can I tell you what my hypothesis was on the spot? It was that she <u>wanted</u> the new kid absent. And <u>I</u> wasn't willing to say that either, because there he was on my right... My response was, 'Oh, no Penny, J.C. is here. He is here next to me, and you have to deal with reality. He is number twenty-two and that is an emotional reality that we have to come to grips with!'

Teachers' work requires the ability to continually improvise actions in response to their students' errors -- actions which serve both to teach and to keep the whole situation under control. In discussing her experience with Penny in the seminar, Diane was asking for help in practicing this kind of improvisation while paying attention to the student's way of constructing the answer. She admired a member of the project staff for having such an ability:

> I wanted you there, because I knew you would ask her the right question. I kept saying, 'this is perfect, Diane, get it out!' But I couldn't think of a question to ask. Of course, I <u>was</u> worried about a few other items... I couldn't de-fuse her anger because I couldn't understand what she was talking about. And I didn't have the time-- I tried -- I gave it three sentences.

On the spot, Diane needed to balance her attention between individuals and the group, between teaching and control. When the occasion demanded, she took her mind's eye off the group for "three sentences". As she talked about what she did, Diane revealed her expectations of herself as a teacher.

The crucial problem, as Diane saw it, was Penny's need to get the new boy absent. She was less concerned about the arithmetical error involved in counting him twice. She believed Penny could have been readily corrected in that matter:

> If she was, in fact, counting J.C. twice, or willing to think about counting him twice, instead of getting rid of him, like shooting him between the eyes, then she would have gone with that.

The arithmetical error was complicated by its association with an emotion-laden moral error.

Perhaps the arithmetic error was less troublesome because the teacher knew from other situations that Penny "is very bright, competent, and knows the difference between twenty-two and twenty-five, twenty-three and twenty-four. She can count by ones and all of that." But Penny did nonetheless make the error, and she herself worried about it. The teacher's assessment of the situation took into account other things she knew about Penny as well: "Penny really doesn't offer much at meeting, so it was clear that she was concerned with how these numbers were coming out, or concerned about something." Twenty-three in the class before, plus one new child, makes twenty-four unless maybe you think, it makes one too many, and you want to express that somehow.

One of the teachers in this discussion gave a particularly lucid statement of the dilemmas involved. She started out seeming to expect to find simple answers, but her final words revealed a recognition that such answers would be distressingly elusive:

> Is your purpose as a teacher to prove to her that she is wrong and you are right? Or is it to make her unangry? Or is it to have her find out somehow that she is wrong? In other words, should it be made into a learning process for her to discover the right answer? Should you somehow be able to prove it to her? Or is what you want to do to make her comfortable, somehow? She obviously wasn't comfortable; she wasn't angry and mad, I don't know what your purpose should be, even. (Lee)

Underlying all of these questions is the fundamental query: "What are the teacher's responsibilities as the single adult in the classroom?"

Talk about the purposes of schooling is pervasive in literature. The issues get dissected into sociology, cognitive and affective psychology, philosophy, anthropology, politics, economics, and the like. But the arguments found there often seem quite distant from moment-by-moment life in classrooms, indeed, they usually seem quite unrecognizable to those who live and work in classrooms. In the course of their own examination of their work the teachers sought answers which would make sense in their everyday experience.

The discussions among these teachers took place outside of any academic framework. The lack of such a framework was often frustrating to them because the teachers believed that the academic world should be able to provide them with answers to their difficult questions. We continually encouraged them to seek their own answers, both to questions about teaching and to questions about music or the moon or mathematics. This encouragement was often taken as dishonest, however -- we were suspected of keeping secrets, of making it unduly hard for them.

Yet as the teachers talked about their work, it became clear that their purposes in the classroom could not be a matter for academic argument. As they live with their students and teach them, teachers do not choose one "best" purpose

and forget others. The dissections of academia are counterbalanced against the situational need for the teacher to rely on her own judgement. She does not often have the opportunity to consult answer books or curriculum guides or other teachers to find out what to expect of students or what is worth teaching. She is an adult person, she knows what life requires of her, and she endeavors to prepare her students "to come to grips with it." (Di)

Facing the Realization that Answers are Actively Constructed Rather than Passively Received

A sense of the significance of each person's conception of something, whether it be the purposes of teaching or the phases of the moon or the ending of a tune, developed slowly over the two year period during which the teachers me.. The realization that we each construct our own knowledge in our own ways out of what we learn from teachers and books and experience was articulated at various moments during that time, but the search for objective "right answers" continued.

A comment one of the teachers made in response to her experience with the different systems of musical notation which were being developed by members of the group, exemplifies the teachers' ambivalence on this issue. This teacher brought her reflections on music notation "home" to her classroom by saying, "I have the terrible feeling that if this process goes too far, I'm never going to be able to assign page 98 again." (Lee)

"This process" is the process of understanding each individual's way of thinking about something. It is the process of figuring out how a child differentiates between "room" and "rooms" in solving a problem in solid geometry (see p. 10). It is the process of developing a notation system that takes account of the "important" aspects of a musical composition (see Part IV).

It is the process of wondering what a student means when he asks "Does Dataman have eyes?" It is the process of constructing an explanation for the changing appearances of the moon. As the teachers searched for their own answers in each of these processes, they also reflected on their role as the providers of answers to children.

What makes recognizing the way each student might understand a set of text book questions so "terrible" for a teacher? Obviously, there is a management issue. It is certainly easier for a teacher to organize her work around the assumptions that the whole class can do the same thing at the same time, and that she can evaluate their performance on the given task using the same standard for everyone. But ease of organization is only the tip of a very craggy iceberg. If you don't have everyone doing the same thing, on what basis do you decide who does what? If you can't evaluate everyone on the same standard, how can you evaluate them? "Individualization" is clearly a lot more work for the teacher (and there's probably been enough said about that), but it can also be a very difficult intellectual issue.

One of the staff members of the project responded to Lee's worry by saying: "It would be interesting to see how all those different mixes of things would interlace with page 98;" i.e., to see what different children, with different prior knowledge and different abilities, would do with the same assignment. She is a researcher, interested in thinking about the connection between what kids "know already" and what they are to be taught in school. To her, different students' unique approaches to the same assignment would be valuable for what they would tell the teacher about what individual students know already.

But another teacher in the group responded that this teacher probably "already knows ... how many different things can be done on page 98," (Di), implying by her tone of voice that having such information would be, not interesting, but troublesome. If it is the teacher's job to get students to give right answers, wrong answers have a functional meaning only in that they indicate that the job has not yet been accomplished. (How teachers can get a feeling of accomplishment is a particularly deep and cold part of that aforementioned iceberg.) The expectations a teacher has for herself and her students are, for the most part, not very well defined. So there is a certain routine comfort in getting everyone to do the same assignment correctly, and there is little that is comforting about recognizing that a variety of "wrong" answers may result from each student's unique interpretation of an assignment.

Different ways of thinking about a problem might be more interesting and tolerable to teachers if they all led to a right answer (as in different schemes for representing a long division problem). But from the teacher's perspective, it seems reasonable for her to search for one "best" way of thinking about something and to get everyone to do it that way. Then the teacher does not have to worry about the consequences of allowing a student his/her unique way of thinking if that way doesn't lead to a right answer.

In this conversation about the variations in the ways individuals might understand and solve the same problem, Lee commented about the teacher's edition of a textbook she was currently using with her 4-5th grades: "Every other page, every other page in my teacher's edition now -- in the good old days, you know, it said 'answers are numbers 1,5,6' -- and now, now it says,'answers will vary.'

Answers will vary!! So this is a terrific teacher's edition!!" One senses that Lee isn't at all convinced that it is nice to allow for variations in thinking: teacher's editions in the "good old days", told you exactly which answers were the right answers.

If the teacher's edition says "answers will vary", it is up to the teacher to decide which among the variations is acceptable and which indicate that the student simply does not know what he/she needs to know. The teacher who can rely on textbooks and standardized curricula to provide guidelines for what students need to know, how "well" they need to know it, and by when they need to know it, does not need to be an expert in every subject matter she teaches. Nor does she need to know a whole lot about intellectual growth and development. But most significantly, she does not have to continually make a personal judgement about what is worth knowing.

"The community" provides teachers with direction in the form of teacher training schools, curriculum guides and textbooks, and policy and personnel decisions made by elected public bodies and their employees. These are supposed to prevent the teacher from going too far in the direction of her own idiosyncratic sense of what's worth knowing or doing. The "right answers" and the "right behavior" are not determined solely by the teacher in any case, and some educationists are attempting to get the teacher's judgement out of the process altogether. The assumed "ideal" in this process is agreement among teachers and everyone in the community about what constitutes adult competency and how schools should work to produce it.

In the "real" world, on the other hand, kids learn, in the process of growing up and leaving their families, that all adults do not necessarily agree with one

another about the "right" answer or the "right" thing to do. Yet it is also true that throughout adulthood, we keep hoping that there are right answers and right things to do, and wishing someone would find them out and tell us what they are. At the same time, we experience significant clashes between the right answers that the authorities are giving out and the right answers we come to based on our experience. The teachers participating in this project personally experienced these conflicts quite dramatically as they reflected on their own ways of thinking about math or music or science.

Lee expressed the implications of these experiences for teaching the standard curriculum:

> I mean, if you take it to its logical conclusion, the assumption is that everybody's coming with layers of knowledge to any given task, and almost any accomplishment of that task, no matter what -- there's going to be a wide range of abilities and accomplishments on a given task also. So it's going to be very hard to give coordinated assignments in the class. (Lee)

That this concern goes beyond the possible organizational problems that might arise from individualization seems clear from the way the teachers have discussed other issues in the seminar. On several occasions, they have expresses their own intent to find the right answer. They have felt frustrated at their own inability to solve problems "correctly" because of the inaccuracy of the available tools. They have recommended asking experts to tell them the answers when they are puzzled about something and they assume experts will know and agree on the answers they seek. They have expressed a dislike for working on problems unless they can be assured that they are solvable and that someone will recognize the correct solution when it is found.

"The right answer" has a powerful appeal for teachers: besides the fact that agreeing on "it" would make their job easier, they share the general

feeling that until "it" is found, the anxious search must continue. Its appeal is at the base of many ambivalent classroom practices reported by the participants such as: Suzanne's reluctance to reach students her way of representing long division problems, even though that way is easier for her than to understand "the one in the book"; Helen's practice of getting the required curriculum done in the morning and keeping "thinking games" for the afternoon; and Diane's separation of her academic expectations from her knowledge about how children think about social problems.

There is an implied devaluation of "my way" of doing things when "my way" does not coincide with "the right way". Yet at the same time, there is the experience that, in some sense, "my way" is the only way there is, and that is lonely and frightening. In the abstract, this may seem like a simple problem of relativity vs. absolute truth, but in reality the problem is not so easy to dissect. It is in the large area between the belief in "one right answer" and the belief that "any answer is right", that the teachers in this group have been struggling for two years. The question is not really whether or not there are right answers. Rather it is a question of whether learners acquire them from teachers; if so, how; and what the answers mean to the persons who know them.

The complexity and practical relevance of this issue is best summarized in a piece of writing one of the teachers produced at the end of the project. She related her own process of learning to explain the changes in the appearance of the moon to her role in the classroom as the arbiter of right answers:

I can put this off no longer and I still don't know where to begin, what direction I should take and where it, ultimately, will all end. I have put off the task of writing because I fear(ed) failing. I fear(ed) being unable to put into words the thoughts that have become a part of my life since April 1980. Truly, my life is changed because of these thoughts. I am excited, happy, curious and just basically thrilled about my discoveries - Ridiculous? Not to me and I would like to share that with you all and I am so afraid of not doing it well enough.

The magic word is "answer". Where do I begin with the concept I now have of that word in contrast to the understanding I have had for 31 years? Everyone else had answers- better answers than I, certainly. The answers were had by authors of books, by producers of films and programs, by administrative personnel in the Cambridge Public School System, by the teachers in the other classrooms, by my college professors, by you - need I continue? In other words everyone had a "correct" response to anything and everything, a better response than I because they somehow "knew" more. A different teacher would know just how to teach the sound of b in a meaningful way. Another teacher would know exactly why Adam is unable to sit still and would also know, from her reserves of knowledge, probably, just how to change that behavior to a more acceptable one. Another teacher would know the importance in an individual's life of having him sit still as a statue in first grade and would therefore not have to question the rationale for enforcing such discipline.

Because others had answers- especially in teaching- there were secure. They had the answer that made what they were doing unquestionable.

There is security in thinking that there is one answer. That somewhere out there, there is one right response to a given situation. If a system has worked for years under a certain set of assumptions then one's responsibility is to learn about that system and master it so that we can act in such a way so as to preserve the system. The system is the answer. We must mold ourselves to <u>fit it</u>. <u>It</u> is the end rather than a means to an end.

Boy, how silly! What we must do to develop an understanding - I use the word "system" to mean just about anything; school, task, social organization - society - of the system so that we can explore ways of making it better. Historical precedence does not mean <u>future mold</u> it means <u>future consideration</u> - something to keep in mind when trying out a new approach.

It is risky to try something new.

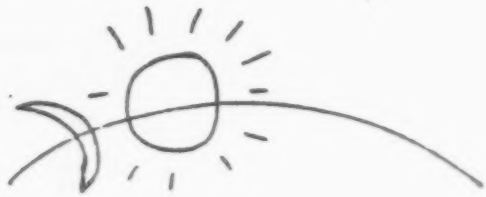
I have said this elsewhere, I know, but it takes self-confidence developed from self-awareness <u>and</u> self-appreciation.

Somehow this is what we need to "<u>teach</u>". We need to help the children we work with see this in themselves...

The Moon

Many times I wondered why the heck we were bothering to look at it. Sure we were finding things out about it. Often times I would have a definite question to which I wanted to provide an answer. My observations were then focused on that point. Then I at times could not think of what to ask next - what else I wanted to learn. Others at seminar helped a great deal with this. They would say something which I had not thought about that would open up a whole new avenue - another reason for looking - questions I had not thought of.

What happened 2 months ago is that everything clicked, the morning I came up with this:



The looking we had done all came together for me. I had answered a question simply by looking carefully. I now had understandings and awarenesses I had never before experienced. I had learned things about the moon that I would not, could not, ever forget. No one could take this knowledge away from me.

Consequently: We can learn anything! We can come up with our own answers if we look closely enough- long enough- carefully enough... I learned so much just by watching! I had learned about the moon in school. I had taken tests to check my knowledge and had performed well. Yet, I knew nothing. Sure, the moon is up there every so often. At times, it's really nice to look at - but.

No one can remove the understandings I now have about the moon. I can spread my arms apart and know about full moons. I can look up in the sky and expect to see the moon at a certain spot. (Marg)

In commenting further on these ideas in a final seminar discussion, Margot compared herself to her first grade students:

"I realize that these little kids are secure, someone else has an answer for them. Someone else. There's security in thinking that someone else can tell them how to do something and it's nice to have the security of doing a paper a certain way, putting your name a certain place because it is correct in someone's eyes, someone above you. And in many regards, I was like the first graders, and was secure in thinking that there were, you know, that someone else had the right answer. Cause then I wouldn't have to, there was no -- no, it wasn't that I wouldn't have to. The possibility of my discovering a better solution was just not, not, not even there." (Marg)

It is clear that "teacher development" in this project has meant nothing less than a fundamental reexamination of the nature and the responsibility of teaching. We have tried to provide a setting in which teachers could come at the meaning of this knowledge from a variety of perspectives.

We have learned, and we think the teachers have learned, that what psychologists "know" does not translate easily into teaching practice. By exploring the possible "applications" of cognitive theories to work in classrooms, with a group of people who face students as teachers, every day, we have identified issues of interest to both researchers and practitioners.

The problem of what it means to find "the right answer" was an organizing theme of our research on at least three different levels. First, the teachers were engaged in solving problems in which they were called upon to surface, make sense of, and use their personal knowledge of music or physics or mathematics or astronomy. Their experiences with these problems in turn raised questions about how they understood and made use of the "facts" contained in books and curriculums.

Second, the teachers were involved with us in a search for appropriate methods of professional self-development. This search became a highly personal process as the teachers responded to our reluctance to provide them with a pedagogical formula for the right way to teach. Again, we all learned that the meaning of the answer to the person who knows it is significant.

And finally, as researchers, we have all learned that conceptual closure is impossible when an inquiry honestly takes account of the context in which answers are sought. While we have discovered no easy answers to the problems of teacher development, we have learned a great deal about the nature and the complexity of the process.

PART VI: CONCLUSIONS

While we have tried to document in this report the kinds of work we, the adjunct teacher, and the teacher-participants did, and to give some sense of the quality of change that occurred, the report is hardly complete in its analysis of the data. It is thus our purpose in the coming year to provide much more complete evidence of the effects of the project and also to account for changes which occurred, in terms of the procedures which contributed to them. We thus conclude this report with a summary of the work we are undertaking towards further analysis of the data as well as the kinds of questions that have emerged as a result of our work to date.

We are conducting this analysis largely through case studies, fleshing out such mini case studies as are presented in Part II of this report. The case studies are of two sorts - documenting the development over time of a few participants; and documenting the development of an idea or a theme that played a prominent part in the work of the seminar.

The questions we seek to address through these studies include the following constellations:

Adjunct Teacher:

As mentioned on page 4 , during the second year of the program we added an adjunct teacher to the staff who spent one half-day per week in each of the classrooms of 6 of the teachers in Group A. The effect of her work went far beyond our expectations in achieving the goals of the project. Thus, we need to probe further in answer to such questions as:

How did we define her task?
How did she define her task?
What specific means did she use in helping the teachers to reflect on their own practice?
What were the means used and the results of her observations of both teachers and children in the classrooms?
How did she succeed in meeting each teacher on her own terms -- i.e., in engaging their issues without imposing her own?
How did she help the teachers to relate the seminar to their classrooms?
How did the seminar help her to find common ground with each teacher?

Group B:

We added a second group of teachers to the project on the hypothesis that this would allow us to test some of our developing notions about the important elements of the work with the first group.

How did the procedures differ across the two groups and to what effect?
What were the common elements in the development of the two groups?
What was the influence of and on the three teachers from the original group who attended these sessions as well?
What was the difference in effect between a one-year and a two-year program?

In this regard:

Is this extended time period a necessary factor in achieving effective results?
If so, to what extent is this a function of the cognitive risk-taking involved, as well as the need to develop trust in the process and in interpersonal relations?
Is it possible to cull from our experience strategies that would compress the two-year period of development; or is the time factor of the essence in the kind of development that took place?

Learning on Two Levels:

As indicated above, a primary force in the project was the interaction between learning about some particular subject matter, and learning about learning. This interrelationship raises several intriguing questions:

How did we succeed in creating the movement back and forth between these two levels of cognitive issues?
Which subject matters were most effective to this process and why?
Why, for instance, did nearly all the participants in Group A become deeply engaged with their observations of the moon, resulting, over an 18-month period, in the evolution of highly sophisticated understanding despite their being "given" practically no information from the staff?
Why, on the other hand, did the music activities tend not to engage the majority of teachers on this level? How does this reflect, in particular, on the state of knowledge associated with the two domains, and its relation to educational practice?

Teacher as Researcher:

The original proposal developed the notion of the teacher as teacher-researcher. These views underwent significant change in the course of the project.

What contributed to these changes -- e.g., academic models of research vs. the practice of reflection-in-action in the classroom?
Can we develop a better model of the teacher-researcher based on the present data?

Teacher as Teacher:

Finally, there is the teachers' work in their classrooms, and the nature of the interplay between that work and this project. Half of them continue to meet on a volunteer basis, and so this interplay continues to evolve.

How do the teacher relate their understanding of children's learning to all of their other responsibilities as teachers?
What changes have taken place in their interactions with children?
What changes have taken place in their purposes as teachers?
What changes have taken place in their views of teaching as a profession?

The complexity of the project, particularly the intertwining of active practice, reflection, experiment, with interpersonal relations, individual learning and change, demand the invention of a kind of documentation and analysis which will reflect this perhaps unique mix, rather than distort it in the service of "objectivity". Indeed, the results of the project must be described in terms which are meaningful not only to the academic community but also to teachers and to the education community generally. In particular, the analysis and documentation of the project should be recognizable by the teachers who were its participants. This is the focus of our current work.

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APPENDIX A

RECRUITMENT NOTICES

1. First year

2. First year, follow-up

3. Second year

4. Second year, follow-up

5. Adjunct teacher

DIVISION FOR STUDY AND RESEARCH IN EDUCATION
Room 20C-108B

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS 02139

(1.)

September 11, 1978

The Division for Study and Research in Education at MIT has just received funds for an experimental project to explore the notion of "teacher-researchers." The project will depend on the participation of eight elementary school teachers who will serve as consultants to the staff. This notice briefly describes the project in the effort to seek out teachers who might be interested in participating.

The program will run for two years, beginning in the fall of this year. The first year is a more intensive one; the second year, as a follow-up, will require less time. During the first year (October through June) teachers will meet after school hours at for a three-hour seminar once a week. They will be paid $500 for their participation, will receive a small budget for expenses incurred, and will receive course credit at Lesley College if they so desire.

Teacher Researchers

The term "teacher-researcher" has been used in a number of different ways. In this project we use it to suggest an active way of thinking about a teacher's work. We are thinking of "research" as applied and practical - the essence of a teacher's day-to-day work. The domain of study is children's intellectual vitality; the work is to help children coordinate their own intuitive knowledge (that is, what and how they know already) with the more formal knowledge taught in school. A teacher-researcher would devise curriculum activities which probe the limits of children's knowledge, while at the same time contributing to the further development of that knowledge.

The Proposed Seminar

Teachers, like all of us, have gained their knowledge through a combination of schooling and ordinary day-to-day experience. We believe it is important for teacher-researchers to develop an awareness of how everyday knowledge is related to what is formally taught. We propose a series of seminars in which teachers can engage in hands-on activities for the sake of exploring their own ways of learning and doing. What is it that we "know," for example, when we know how to get from home to Symphony Hall?

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What have we learned additionally when we can make explicit our intuitive knowledge? How does our knowledge of how to get around in Boston relate to our knowledge of grammar or geometry?

By learning to reflect on their own knowledge we hope that teachers will learn to help students make explicit their intuitive knowledge - knowledge which is often effective and even powerful, but also often different from what is recognized in school.

We do not propose a packaged set of competencies nor a cookbook of procedures. We propose, rather, an arena for stimulating teachers' on-going experiments into the nature of learning and thinking.

To Summarize

We would like to explore the notion of a teacher researcher - a person who is able to describe explicitly specific learning experiences, and invent curriculum which will expose the learner's intuitive knowledge at the same time as it expands that knowledge. Our major questions are the following:

- Is the model of teacher-researcher a practical one?
- What are the effects in classrooms of a teacher-researcher approach?
- What is involved in helping teachers become teacher-researchers?

We are looking for eight teacher-collaborators to help us answer those questions.

Qualifications

Elementary school teacher responsible for a class (that is, not a specialist teacher);

Available for a three-hour seminar once a week at a generally agreed-upon time;

Willing to keep a journal-type written account of the experience each week;

Starting sometime in the New Year, willing to make some attempts as a "teacher-researcher" in his/her own classroom, and to have these attempts serve as material for reflection in the seminar;

Interested in relationships between intuitive and formal knowledge;

Sharing our view that any serious learning involves a good deal of playfulness and open exploration, as well as a certain amount of risk-taking.

For further information please contact Maggie Cawley or Eleanor Duckworth at the

Division for Study and Research in Education
MIT
Room 20C-108B
Cambridge, Massachusetts 02139

253-7374.

We would like to include a variety of people in the project. If you are interested in participating, please fill out the attached questionnaire and return it to us at the above address before October 6.

Name_____

School_____ Grade Level_____

Home Address_____

Phone_____ Number of Years Teaching Experience____

Why are you interested in participating in this project?

_____

_____

_____

_____

The following are possible times when the seminar might meet. Please cross out those times when you cannot attend and circle those times which you can attend.

Monday	Tuesday	Wednesday
3:30 - 6:30	3:30 - 6:30	3:30 - 6:30
5:00 - 8:00	5:00 - 8:00	5:00 - 8:00
7:00 - 10:00	7:00 - 10:00	7:00 - 10:00

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September 26, 1978

MEMO

To: Elementary School Teachers

From:

The Division for Study and Research in Education at MIT has just received funds for an experimental project which depends on the participation of eight elementary school teachers to serve as consultants to the staff.

The program will run for two years, beginning in the fall of this year. The first year is a more intensive one; the second year, as a follow-up, will require less time. During the first year (October through June) teachers will meet after school hours at MIT for a three-hour seminar once a week. They will be paid $500 for their participation, will receive a small budget for expenses incurred, and will receive course credit at Lesley College if they so desire.

Your school master has received a brief description of the project. An informational meeting will be held for all those interested on Tuesday, October 3, at 3:15 in the Fitzgerald School auditorium. If you cannot attend the meeting, application forms are available in the school master's office.

3.

DIVISION FOR STUDY AND
RESEARCH IN EDUCATION
Room 20C-108B

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS 02139

August 30, 1979

INVITING YOUR PARTICIPATION

As a teacher, you are concerned, everyday, all day, with children learning. What happens when a child learns something? What happens when you learn something? How do you take what you already know and change it to fit new experiences or information? How do you use what you know in your everyday activities? How would it affect your teaching to look more deeply into some of these questions?

As part of an experimental project in teacher development at M.I.T., we've been discussing these difficult issues -- and more -- with a group of Cambridge elementary school teachers for the past year, and we'd like to begin another new group this Fall. "We" are Jeanne Bamberger, Associate Professor of Education and Music at M.I.T.; Maggie Lampert Cawley, who has taught elementary and high school, has been involved in teacher education for six years and has done research on the teacher's experience of adulthood; and Eleanor Duckworth, whose main interest is in trying to make the findings of cognitive psychology helpful to teachers. Our purpose is to expand on our ideas about thinking and learning and teaching with the help of people who have everyday experience with life in classrooms -- you! In the seminar, we would hope to be able to help you develop insight into your own learning and thinking processes and through this, insight into the learning and thinking processes of the children with whom you work.

You will work on some actual problems together to see how you use what you know and how you cope with new situations. Last year, for example, the group tried to invent machines from simple materials which would measure a unit of time and we tried to figure out what it is that makes a collection of notes into a sensible "tune." The focus was not on the specific subject matter of physics or music or whatever else we did, but on what could be learned about our knowledge-in-action. We discussed many examples of children's knowledge-in-action which teachers brought in from their classrooms, and thought, together, about how to respond to a child's way of understanding something when it was different from the conventional knowledge that is embodied in the curriculum.

As last year, the new seminar will evolve continually as we explore questions that come up, so regular attendance will be necessary. We will meet every other week on Tuesday from 4:00-7:00 p.m. Some reading will be suggested when it might help make sense of things, and we would like you to keep a journal of your thoughts about learning and teaching. Money is budgeted in the project for use by individual teachers, including graduate credit from Lesley College, if desired.

If you are interested in participating, please fill out the attached questionnaire and return it to us before ~~September~~ Oct. 1? at the above address. We will meet with everyone who applies to discuss the project in more detail. The seminar will be limited to 8 participants.

TELEPHONE 253-7374 100

Name:_____

School:_____Grade Level:_____

Home Address:_____

Phone:_____ Years Experience:_____

How are you interested in participating in this project?_____

_____

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DIVISION FOR STUDY AND
RESEARCH IN EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS 02139

September 20, 1979

REMINDER

Teacher Development Research Project

You are invited:

To explore learning and thinking processes - your own and those of the children you teach.

To meet every other week on Tuesdays at M.I.T. from 4:00-7:00p.m. with a group of eight of your colleagues.

If you are interested, please contact:

Jeanne Bamberger

Maggie Lampert Cawley

Eleanor Duckworth

Division for Study and Research in Education
Room 20C-108B, M.I.T.
Cambridge, MA

For more information, see fuller description on your bulletin board.
Call 253-7374 or talk with one of last year's group:

Jinny Chalmers	King Open School
Joanne Cleary	Tobin Magnet School
Mary DiSchino	M.E. Fitzgerald Primary Unit
Corinne Gaile	Morse School
Mary Rizzuto	Gore Street School
Pat Tabors	Webster School
Susan Wheelwright	Agassiz School

Graduate Credit at Lesley - Stipend - Budget for materials - Dinner provided

DIVISION FOR STUDY AND
RESEARCH IN EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS 02139

August 30, 1979

POSITION AVAILABLE

The Division for Study and Research in Education at M.I.T. is seeking, for immediate half-time employment, a certified elementary school teacher with at least two years' experience to participate from September 1979 through June 1980 in an experimental teacher development project. Seven Cambridge elementary school teachers work in the project along with three staff members from M.I.T., thinking about and developing a relationship between their own ways of knowing and learning and those of the children they teach.

The job will include:

1. Work in each of the participating teachers' classrooms, freeing her up to pursue special activities related to the seminar.

2. Observe and share in on-going activities in the respective classes and discuss mutual observations and issues with individual teachers.

3. Adapt to the wide range of teaching styles of the project participants.

4. Participate in weekly seminars.

5. Keep a journal on experiences, both in the classrooms and in the seminar.

For information, call 253-7374. Please send resume and letter of application to:

Teacher Development Project
D.S.R.E. Room 20C-126
Massachusetts Institute of Technology
Cambridge, MA 02139

APPENDIX B

EXCERPTS FROM THE ADJUNCT TEACHER'S REPORTS

For the most part my job has involved listening - listening to teachers describe children, the children's work, specific curriculum ideas, involvement with parents, or their ideas about the profession, the role of a teacher, the system, political events, and their own career dilemmas. Listening with effort to understand is a process much underplayed, and yet it is crucial to the complex process of teaching and learning. Listening requires a greater discipline than that of a short term memory and a warm smile of encouragement towards the speaker.

In observing a child, our notes reflect our individual criteria for observing, and our biases and values. In a similar way it is important to note the extent to which there are also these influences upon our ability to listen. Listening may then be an "art" developed through constant reappraisal of one's own attitude, rather than a skill with X number of techniques to be employed.

Being cognizant of the levels of meaning expressed by an individual, and of your own focus in listening, is a demanding activity. Listening for content, that is, the words, is one aspect. By this I mean noting that some of the words seem familiar and others are strung together differently. Listening viewed from another, perhaps richer, aspect involves one beyond the literal understanding. It involves listening (with a third ear?) for the assumptions that the speaker makes about the topic. It is perhaps the most difficult part of listening because it means trying to understand another person conceptually, experientially, and emotionally. It is in this way that I see listening as an aid to under-

standing a teacher's comments, action, or "way of seeing" their classroom, an individual, their role, or learning. For my work to be productive - having teacher's feelings satisfied as well as mine - I needed to recognize, understand, and communicate respect for the teacher's individual assumptions and feelings.

Keeping this attitude open and uncluttered by biases has been a progressive and instructive concentration. My relationships varied with the teachers, and new subtleties and complexities of this position were illustrated to me.

In the case of one teacher, whose approach to life in the school setting was very different from mine, the channels for listening and engagement with one another took a long time to develop. We worked quite separately in the classroom, slowly establishing trust. Initially, perhaps we were only trying to understand one another's role. In this situation commonalities could not be assumed, as for me there were few familiar materials or methods being employed; I found my capacity to listen in the fuller meaning of the word was challenged.

Only after I made every endeavor to recognize her personal views or reasons for teaching - to think as she did - did we begin to work with a rewarding sense of cooperation. Somewhere in the trusting there was a separation of the roles from the people. I was not her super teacher nor she my student. As our preoccupation with roles dropped, communication become more meaningful. There was a sense of sharing, rather than defending, one's ideas and integrity. I felt as if only when she felt absolutely certain that I was truly listening and not making judgments,

would she trust our dialogues enough to share herself openly.

It takes a long time for some people to be sure that they are heard, and then and only then do they assume responsibility for making sense or meaning of their perspectives and feelings to others. I think that when you fully respect and trust another's effort to "make sense of their world" you can dismantle barriers of communication and provide a valuable context for discovery and learning.

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As a way of exploring further my position, it may be useful to discuss what capacity the participants did not perceive me in, as well as roles that I did not act on. Generally, I was not:

(a) A counselor/confidant - one trusted with secrets inclusive of personal aspects of their lives, families, children, lovers or troubles. Although we did speak with relevance to the day's pressures or events (personal or school-wise), we did not chit-chat about events randomly.

(b) An evaluator - there was no formal evaluation of the teacher's capabilities passed onto supervisors, principals, etc. I did, however, take copious notes-observations of class events, maps of classroom arrangements, use of material, rhythm of activity, which were shared and handed to the teacher directly afterwards, and for our personal use only.

(c) Curriculum specialist - I was not there to offer/expect the teachers to accept facts on "how to" or the latest preferred methods for social studies or math or any specific curriculum area.

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In general, talks centered around these topics:

- similar and different perspectives on observed events in classroom;
- descriptions of children individually (social/academic) and as a group (class management);
- related meaning of seminar topics and ideas to classroom, to self as learner;
- analysis/diagnosis of child's understanding; naming possible needs/activities/evaluation of it;
- ideals of teaching - philosophy - actual individual practices;
- particular school politics;
- interactions between teacher-child, child-child;
- the need, the "why", technical problems of/benefits of/observing in the classroom;
- shared expertise in specific curriculum materials; and
- career choices - professional roles in education.

****

In most cases, my visits were scheduled by the individual teacher in regards to morning or afternoon activities going on in their classrooms. My visits were scheduled for a specific time and rarely left to the "drop by" approach. Some patterns began to develop in the scheduling:

(a) same time each week, same day (MD);

(b) after basic work (reading) was completed (MR);

(c) any time, a variety of times (CG, GC); and

(d) same time each week to be present for specific activities (JC).

In some cases the scheduled times changed, as well as the use of the adjunct teacher. Factors that are relevant to these changes are:

(a) depth of our relationship/willingness to be self-evaluative;

(b) perception of teaching-learning and when and how it takes place; and

(c) interrelatedness of social-intellectual development of children.

It was to my advantage to have no formal power over the teacher participant's particular job or career future. Although I made efforts to preserve a non-evaluative stance and a neutrality, in some dialogues there were instances where not withholding intuitions, values, knowledge and experience was valuable and increased the participant's acceptance of me personally and/or the veracity of ideas, notions. And so to me, withholding personal ideas seemed counterproductive at times. On the otherhand, it seemed that offering too much of "what I think" could have been unwise as well. Finding the balance between self-disclosure and detached querying was a process I had to learn. When the balance was met, it did provide ground for mutual respect in a "working" relationship. This desired working relationship may also be described as peer support, or a reflective partnership.

Preserving a confidentiality and non-judgmental atmosphere promoted self-reflection on the teacher participant's part as well as on my part. As we worked together in the classroom and in the seminar, personal differences and similarities became apparent. Teachers, to varying degrees, responded to this with respect and understanding of themselves and of their children.